



Hacettepe University Graduate School of Social Sciences

Department of Economics

Ecological vs Environmental Economics: How Ecological Economics Influenced Human Development Reports?

Mehmet Delil YORGUN

Master's Thesis

Ankara, 2025

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ACCEPTANCE AND APPROVAL

The jury finds that Mehmet Delil Yorgun has on the date of 23.06.2025 successfully passed the defense examination and approves his Master's Thesis titled ``Ecological vs Environmental Economics: How Ecological Economics Influenced Human Development Reports?''.

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ETİK BEYAN

Bu alıřmadaki bütn bilgi ve belgeleri akademik kurallar erevesinde elde ettiđimi, grsel, iřitsel ve yazılı tm bilgi ve sonuları bilimsel ahlak kurallarına uygun olarak sunduđumu, kullandıđım verilerde herhangi bir tahrifat yapmadıđımı, yararlandıđım kaynaklara bilimsel normlara uygun olarak atıfta bulunduđumu, tezimin kaynak gsterilen durumlar dıřında zgn olduđunu, **Doent Dr. Onur YENİ** danıřmanlıđında tarafımdan retilildiđini ve Hacettepe niversitesi Sosyal Bilimler Enstits Tez Yazım Ynergesine gre yazıldıđını beyan ederim.

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ABSTRACT

YORGUN, Mehmet Delil. Ecological vs Environmental Economics: How Ecological Economics Influenced Human Development Reports?, Master's Thesis, Ankara, 2025.

This thesis examines how ecological and environmental economics have shaped the discourse of sustainability in the United Nations Development Programme's Human Development Reports (HDRs) from 1990 to the present by using a qualitative and interpretive research methodology. The analysis considers key concepts such as natural capital, resilience, planetary boundaries, and intergenerational equity, tracing their appearance, frequency, and contextual use in HDRs over time. In addition to drawing on the established frameworks of ecological and environmental economics, the study incorporates a Marxist ecological perspective to critically assess the structural political-economic constraints that influence the adoption of sustainability concepts. A qualitative documentary analysis is combined with manual literature mapping to identify the extent and nature of ecological economics' influence on HDR language and framing. Findings indicate that ecological economics has become increasingly visible in HDRs, particularly after 2010, often through rhetorical adoption of its terminology and principles. However, this uptake has rarely translated into a fundamental shift in the HDRs' underlying policy framework, which continues to be shaped largely by mainstream economic approaches. The Marxist ecological perspective highlights how this pattern reflects deeper systemic contradictions, where rhetorical commitment to ecological sustainability coexists with a growth-oriented development paradigm. The thesis advances the body of literature on sustainability transitions by outlining the conceptual avenues along which international development policy is influenced by economic thought.

Keywords

ecological economics, environmental economics, sustainability, Human Development Reports

ÖZET

YORGUN, Mehmet Delil. Çevre İktisadına Karşı Ekolojik İktisat: Ekolojik İktisat İnsani Gelişme Raporlarını Nasıl Etkiledi?, Yüksek Lisans Tezi, Ankara, 2025.

Bu çalışma, 1990–2025 döneminde Birleşmiş Milletler Kalkınma Programı'nın (UNDP) İnsani Gelişme Raporları'nda (İGR) ekolojik iktisat ve çevre iktisadı yaklaşımlarının sürdürülebilirlik söylemini nasıl şekillendirdiğini niteliksel ve yorumlayıcı bir araştırma metodolojisinden yararlanarak incelemektedir. Çalışmada doğal sermaye, dirençlilik, gezegensel sınırlar ve kuşaklar arası adalet gibi temel kavramların ilgili dönemde yayınlanan İGR'lerdeki görünümü, sıklığı ve bağlamsal kullanımı izlenmiştir. Çalışma, ekolojik iktisat ve çevre iktisadı çerçevelerinin yanı sıra, sürdürülebilirlik kavramlarının benimsenmesini etkileyen yapısal politik–ekonomik kısıtları eleştirel biçimde değerlendirmek amacıyla Marksist ekoloji perspektifini de analize dâhil etmektedir. Nitel belge analizi ile elle yürütülen literatür taraması birleştirilerek ekolojik iktisadın İGR diline ve çerçevesine olan etkisi ortaya konulmuştur. Bulgular, özellikle 2010 sonrasında, İGR'lerde ekolojik iktisat kavramlarının giderek daha görünür hâle geldiğini, ancak çoğunlukla söylemsel düzeyde benimsendiğini göstermektedir. Bu benimseme, raporların temel politika çerçevesinde köklü bir değişime nadiren yansımış; ana akım iktisadın etkisi baskın olmaya devam etmiştir. Marksist ekoloji perspektifi, bu durumun büyüme odaklı kalkınma paradigması ile ekolojik sürdürülebilirliğe yönelik söylemsel bağlılığın bir arada var olduğu daha derin sistemsel çelişkileri yansıttığını ortaya koymaktadır. Tez, uluslararası kalkınma politikasının iktisadi düşünce tarafından hangi kavramsal yollarla etkilendiğini ortaya koyarak sürdürülebilirlik dönüşümleri literatürüne katkı sağlamaktadır.

Anahtar Sözcükler

ekolojik iktisat, çevresel iktisat, sürdürülebilirlik, İnsani Gelişme Raporları

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CHAPTER 1

INTRODUCTION

The connection of economic systems to the environment has grown increasingly critical in the midst of advancing ecological crises, planetary barrier crossings, and the increasingly recognized reality that traditional economic growth models are inherently incompatible with long-term ecological viability. Two contending intellectual frameworks have arisen during the past forty years to deal with the challenge, environmental economics and ecological economics, though both strive to incorporate ecological considerations into economic theory from radically disparate foundations, approaches, and normative obligations.

The inspiration for this study arises from a critical reflection: whilst both schools of thought have shaped both scholarly discussion and policy discourse, there is no definitive understanding of which ideas have actually gone on to influence global development agendas, and how. Organizations such as the United Nations Development Programme (UNDP), in their flagship Human Development Reports (HDRs), have significant influence in framing the global sustainability narrative. Yet there has been very little systematic effort to examine whether and through which methods ecological economics, having formally criticized growth-oriented models, actually impacted the metrics and terminology of human development. This thesis fills that gap by marrying theoretical conceptualization with "reverse reference" approaches to follow the conceptual influence of both traditions and gauge their take-up in HDRs across time.

To do so, the chapter begins by examining the historical development of critiques of economics from the likes of Malthus and Mill to the 20th century's ecological precursors. Each of these critiques underpinned both environmental and ecological approaches to

economics, both of which arose in reaction to neoclassical economic theory's perceived failing. In situating the context for the debate, the chapter provides the basis for looking at where and why the different paradigms part from one another, and the importance of understanding each's influence within policymaking in order to move toward a truly sustainable development agenda.

In order to achieve this, the analysis will also incorporate an alternative perspective which is Marxian ecological economics, which stands apart from both environmental and ecological economics while intersecting with their critiques. This approach, based on Marx's theory of metabolism and expanded by contemporary academics such as Kohei Saito and Paul Burkett, offers a critical lens on the structural and systemic drivers of ecological degradation, not only within the confines of market failures or mispricing of natural capital, but as inherent to the logic of capitalist accumulation itself. By including this tradition alongside the two dominant approaches, the study aims to identify how the normative foundations, conceptual tools, and policy orientations shift when the analysis moves from reformist integration of ecological concerns into existing economic structures toward a transformative critique of those structures. Such an inclusion is essential for two reasons: first, it situates the UNDP's Human Development Reports within a broader spectrum of sustainability discourses, including those that explicitly challenge growth dependency; and second, it enables an evaluation of whether genuinely systemic critiques, rather than incremental adjustments, have found their way into global development frameworks. Ultimately, integrating Marxian ecological economics into this comparative framework sharpens the capacity of the research to distinguish between mere rhetorical adaptation of ecological terms and substantive shifts in the metrics, priorities, and policy recommendations that underpin international development agendas.

1.1. THE EARLY RECOGNITION OF BIOPHYSICAL LIMITS IN ECONOMIC THOUGHT

The roots of ecological consciousness within economics reach back to the early political economy, as early economists started to wrestle with the reality of limited natural

resources. Preceding the explicit development of environmental or ecological economics, philosophers such as Thomas Robert Malthus, David Ricardo, and John Stuart Mill incorporated within their ideas some acknowledgment of nature's limitations. Those ideas, although commonly muted by the growth-oriented orientations of neoclassical economics, set the stages for subsequent environmental critique.

Thomas Malthus (1798) was the first to set out explicitly to define a limit to growth in a system. In *An Essay on the Principle of Population*, Malthus contended that if left unconstrained, population would rise at a geometrical rate, whereas food output would rise at only an arithmetical rate, ultimately resulting in famine, pestilence, and social disintegration. As he stated, "The power of population is indefinitely greater than the power in the earth to produce subsistence for man" (Malthus, 1798). Malthus's theory created a fundamental concern within economic thought: natural resources and human needs might get out of balance. Even criticized as underestimating technological advancements, his view challenged economists to take nature's role in directing economic paths into consideration.

This debate was further explored by David Ricardo through consideration of the implications of land shortage. Ricardo's theory of rent, in accounting for income from the most productive land, was premised on the idea of diminishing returns kicking in as lower-quality land is brought under cultivation. For Ricardo (1817), "most valuable and most conveniently situated land will first come to be brought under tillage, and as the people multiply, less productive land must come into play," and thus drive up the rent to limit output. Ricardo's model, abstract as it is, shed light on how land's physical attributes might set structural constraints to economic excess and income distribution. John Stuart Mill, writing later in the nineteenth century, took a more reflective stance on economic growth. While not denying the benefits of industrial advancement, Mill (1848) was one of the few classical economists to imagine an eventual "stationary state", an economy that no longer grows but remains stable and sustainable. As he observed, "The increase of wealth is not boundless: at the end of what they term the progressive state lies the stationary state, when no further increase is possible" (Mill, 1848). Mill's philosophical commitment to utilitar-

ianism and moral progress led him to value qualitative improvements in well-being over perpetual material accumulation. In many ways, Mill's vision presaged the later emphasis in ecological economics on well-being, equity, and long-term sustainability.

Malthus, Ricardo, and Mill together embody a school of economic thinking that inherently acknowledged nature's limits and the dangers of uncontained growth. Despite being later relegated to the background by neoclassical approaches to modeling based on equilibrium, maximization of utility, and substitutability, they provided intellectual ground for later critical critiques of the growth model. Those early warnings, founded within land, population, and moral consideration, reappeared during the twentieth century with renewed importance under the imperatives of environmental and ecological economics.

1.1.1. The Efficiency Paradox and the Thermodynamic Critique

While classical economists acknowledged physical limits in the form of land, population, or diminishing returns, the industrial revolution introduced a new layer of complexity: energy. The British economist William Stanley Jevons, in his 1865 work *The Coal Question*, drew attention to the paradoxical relationship between technological efficiency and resource depletion. Contrary to intuitive expectations, Jevons argued that improvements in coal-use efficiency would not reduce consumption, but accelerate it. As he famously stated, "It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to diminished consumption. The very contrary is the truth" (Jevons, 1865). This principle, now known as the Jevons Paradox, highlighted how capitalist production, driven by efficiency, often intensifies rather than alleviates environmental pressure.

The Jevons Paradox continues to resonate in contemporary energy economics and sustainability debates, particularly in the context of rebound effects from green technologies. His insight reframed the optimism of technical progress, showing that in the absence of structural economic change, innovation alone might deepen resource dependency. Jevons's work represented an early articulation of what ecological economists would later call "growth-induced environmental degradation."

Fast forward a century, and Kenneth E. Boulding's seminal 1966 essay *The Economics of the Coming Spaceship Earth* marked a critical turning point. Boulding distinguished between the "cowboy economy," predicated on frontier expansion and resource extraction, and the "spaceship economy," characterized by closed-loop systems, material limits, and the need for circularity. In Boulding's words, "We are now in a position to see the earth as a single spaceship, without unlimited reservoirs of anything, either for extraction or for pollution" (Boulding, 1966). This metaphor captured both the fragility and the finitude of Earth's systems, urging economists to consider thermodynamic constraints and ecological interdependence.

Boulding's critique was not just ecological—it was institutional and moral. He challenged the deep-seated assumptions of infinite substitutability embedded in neoclassical economics, and anticipated themes that would later dominate ecological economics: sustainability, entropy, and degrowth. His advocacy for a shift from throughput-maximizing economies to steady-state systems laid the conceptual groundwork for post-growth thinking, long before the term gained prominence.

Another towering figure who transformed the discourse was Nicholas Georgescu-Roegen. His 1971 book *The Entropy Law and the Economic Process* introduced the Second Law of Thermodynamics—entropy—into economic analysis. Georgescu-Roegen rejected the mechanistic vision of the economy as a circular flow of income and output, instead proposing an "entropic" vision grounded in irreversible material and energy degradation. As he asserted, "The economic process is not a mechanical equilibrium but an irreversible transformation of low entropy into high entropy" (Georgescu-Roegen, 1971).

This reconceptualization radically challenged neoclassical models that assumed closed systems, perfect recycling, and infinite growth. Georgescu-Roegen showed that matter and energy, once used, lose their capacity to do work—making long-term growth physically untenable. His vision was not merely ecological, but ontological: it altered the very definition of economic activity. In doing so, he became one of the founding intellectual forebears of ecological economics, even as his ideas were marginalized within

mainstream circles.

The contributions of Jevons, Boulding, and Georgescu-Roegen marked a decisive shift in economic thinking, away from abstract models and toward the physical realities of resource use, entropy, and environmental degradation. Their work collectively underscored the necessity of grounding economics in the biophysical world—a task that ecological economics would later take up with renewed vigor.

1.1.2. From Systemic Warnings to Paradigm Shift: The Legacy of *Limits to Growth*

The issues addressed by Jevons, Boulding, and Georgescu-Roegen received empirical support in the 1972 report *The Limits to Growth*, commissioned by the Club of Rome. Applying computer simulations using the World3 model from the Massachusetts Institute of Technology, the report projected exponential economic and demographic growth continuing unabated to exceed the planet's ability to supply resources and absorb pollution, ultimately bringing about system collapse during the 21st century (Meadows et al., 1972). This was the earliest significant effort to incorporate limits within an environment into a dynamic systems model—a far cry from neoclassical economics's fixed equilibrium assumptions.

The response to *Limits to Growth* was both disruptive and polarizing. On the one hand, it ignited global environmental consciousness, inserting the term “sustainability” into both public and policy language. On the other hand, mainstream economists tended to discredit its methodology as “alarmist” and overly theoretical, claiming market processes and technological innovation could bypass such limits (Solow, 1973). This reaction uncovered the widening epistemological chasm between ecology system thinkers and mainstream economists—a schism later to require the development of separate intellectual domains.

In spite of the criticisms, much of the report's long-term projections have been prescient. Later estimates (Turner, 2008; Randers, 2012) showed empirical trends in resource utilization, pollution, and population to follow remarkably close to the report's “business-as-usual” scenario. In hindsight, *Limits to Growth* was not merely a scientific alert but also a

deep philosophical challenge: must economics persist in treating nature as an externality, or must it rethink utterly its very foundations?

1.1.3. Toward an Economics of Nature: The Seeds of Transformation

The cumulative impact of all of these criticisms—starting from classical land and population concerns, going through thermodynamic and system-oriented warnings—paved the way for a new intellectual movement. Environmental economics grew up during the 1960s and 1970s as part of a reaction to internalize externalities and charge for environmental degradation. It still embodied the neoclassical assumptions of efficiency, substitutability, and marginality. It did not have, as authors like Daly (1996) later claimed, the real recognition of the economy’s immersion within the biosphere.

This was not just theoretical failure; it has significant implications for policy. By depending on market mechanisms and cost-benefit calculation, neoclassical economics underestimated irreversible ecological damage and tipping points of the system. As Kapp (1950) had noted decades before, numerous social costs cannot actually be calculated through market prices, especially when they concern long-term damage to the environment and generational justice. His critique of “social costs” explicitly challenged the idea that externalities may merely be internalized with taxes or permits.

The deeper problem was ontological: economics has come to conceive of nature as infinite in quantity, substitutable by one unit for another, and passive—a backdrop to the human drama, not an active co-constituting actor. This metaphysical error narrowed the discipline’s conceptual capabilities for addressing sustainability. It is in this intellectual vacuum that *ecological economics* would emerge, calling for transdisciplinarity founded on systems thinking, ethical deliberation, and biophysical realism.

1.1.4. Conclusion: Rediscovering Limits in Economic Thinking

The historical development mapped in this chapter is one of repeated *deja-vu*: that economic theory which neglects biophysical constraints always misrepresents the nature of economic activity itself. From Malthus's theory of population and Ricardo's rents from land, to Jevons's efficiency Paradox and Georgescu-Roegen's law of entropy, warnings have been sounded, consistently ignored and marginalized.

The failure to incorporate such fundamentals explains, in part, why alternative paradigms became necessary. Environmental economics tried to fix market failures without challenging basic assumptions. Ecological economics, which we will discuss next, emerged to challenge such limitations head-on. It viewed them not as exogenous constraints but as inherent limits to economic existence.

By reconnecting economics to the material conditions of ecology, energy, and entropy, these criticisms invite a radical rethink of value, of development, and of sustainability. This shift is not merely intellectual but existential: how is human development possible without undermining the integrity of the very processes that bring life into being?

The answer, as offered by this thesis, is to compare the divergence of environmental and ecological economics in theoretical underpinnings, methodology, and implications for policy—and how each has contributed to the language of sustainability, particularly in international development paradigms such as the Human Development Reports.

1.2. THE RISE OF ENVIRONMENTAL ECONOMICS: INTERNALIZING NATURE IN A NEOCLASSICAL FRAMEWORK

It was during the mid-20th century that the history of economics intersected with that of the environment. Accelerated industrialization, urbanization, and large-scale pollution crises—such as the London Smog of 1952 and the 1969 fire on the Cuyahoga River in

Ohio—put ecological degradation on the public agenda and on the agendas of policy-makers. Out of this context a new branch of economics was born: the economics of the environment, or environmental economics. Grounded in the neoclassical paradigm, its purpose was not to transform basic theory, but to modify it to internalize environmental impacts. The essence of the new subfield was that pollution and exhaustion were “externalities”—failures of the market which could, at least theoretically, be solved with the help of correct prices.

Among the first and most significant early contributions was from Arthur Cecil Pigou. Pigou, in *The Economics of Welfare* (1920), separated the distinction between private and social costs and contended that when actions by a party impose costs on another party—as with pollution—prices do not indicate the full cost to society. His solution was to impose a tax or subsidy that would bring the incentives to the individual and public welfare into equilibrium. We now term that a Pigouvian tax. Pigou contended, “It is not sufficient to transfer the burden from the injured to the injurer. What is required is to prevent the injury altogether” (Pigou, 1920). This way of thinking led to the foundations of modern-day environment regulation and taxation.

Nonetheless, Pigou’s method was not without its critics. Ronald Coase, in his groundbreaking paper *The Problem of Social Cost* (1960), challenged the requirement for government action in every situation. Coase suggested that under well-defined rights of property and no transaction costs, externalities could be resolved by negotiation of parties without government involvement. This is what came to be called the Coase Theorem. As he contended, “Once the rights of one of the parties are established, the market will take care of the problem of harmful effects” (Coase, 1960). Coase’s ideas were welcomed by those economists who preferred market-based pollution controls, e.g., pollution permits and-tradeable quotas, to command-and-control measures. In the Pigou-Coase debate, the theoretical underpinnings of environmental economics were established. Pigou urged corrective state intervention, while Coase proposed that, in optimal situations, markets would correct themselves. Both doctrines did, however, subscribe to a shared neoclassical assumption: that pollution could be measured, valued, and controlled within the prevailing

economics paradigm. This philosophy laid the groundwork for policy mechanisms like cap-and-trade schemes, cost-benefit analysis (CBA), and environmental assessment plans, that attempted to internalize costs without challenging the basic premise of growth economics.

1.2.1. From Theory to Policy: Cost-Benefit Analysis and Institutionalization

Both the Pigouvian and Coasean methods gave rise to a suite of environmental policy tools that multiplied throughout the 1970s and 1980s. Preeminent among them was cost-benefit analysis (CBA), a technique for determining the net social benefit of policy action by comparing monetized costs and benefits. CBA became a standout feature of environmental regulation after the creation of institutions like the United States' Environmental Protection Agency (EPA) in 1970 and the passage of the Clean Air Act and the Clean Water Act. These statutes required that the protection of the environment be economically justified—a transition that brought economists into key positions within environmental policymaking.

Robert Solow, a lead neoclassical growth theorist, provided a definition of sustainability that was compatible with CBA. Solow, in his widely respected speech *Sustainability: An Economist's Perspective* (1991), contended that sustainability is not required to imply retention of some specific resource, provided that society is able to produce equivalent consumption opportunities or utility for succeeding generations. “If it is extremely easy to replace other factors for natural resources, then there is in principle no ‘issue’. The world is able to get along without natural resources” (Solow, 1991). This definition of “weak sustainability” was a pillar of mainstream green economics, based on maintaining overall capital—natural, human, and physical—as equivalent parts of intergenerational justice.

In enabling a more pragmatic design of policy, this perspective had serious limitations within it. Treating natural capital as substitutable, weak sustainability discounted the potential for ecological thresholds, irreversible drawdowns, and the specific characteristics

of functions of ecosystems. As ecological economist Herman Daly would later contend, the model confused “development” with mere “growth,” and did not distinguish among renewable and non-renewable resources, and services that were actually substitutable versus those that were not (Daly, 1996). Daly called for honoring biophysical limits and a steady-state economy—a position at direct opposition to Solow’s model. In reality, the assumptions of CBA tended to result in underprotection of the environment. Contingent valuation and hedonic pricing methods were plagued by methodological limitations, such as issues of incommensurability, ethical issues relating to the pricing of life and diversity, and distortionary bias when discounting future damages. Critics also raised how marginal analysis—paradigmatic to environmental economics—was powerless to tackle large-scale systemic threats to the environment like climate change, species extinction, or ocean acidification. These criticisms led toward a call for a more fundamental reconceptualization of how the economy engages with the environment, going past price signals and market adaptations.

1.2.2. Market-Based Instruments and the Policy Triumph of Environmental Economics

The development of environmental economics from a body of theory to a practical application reached a peak with the institutionalization of market-based tools like tradable pollution permits. Guided by neoclassical stress on efficiency and Coasean reasoning, the tools became widely used for their perceived flexibility and efficiency. A prime example is the American Acid Rain Program under the Clean Air Act Amendments of 1990 that created a cap-and-trade mechanism for sulfur dioxide (SO₂) emissions. The program was touted as a success: emissions fell, compliance costs turned out to be less than expected, and the market mechanism provided a solution without burdensome regulation (Schmalensee et al., 1998).

These achievements sparked wider implementation of emissions trading schemes globally, such as the European Union Emissions Trading System (EU ETS) and regional carbon-dioxide cap-and-trade schemes. They contended that such instruments reconciled

environmental ambitions with economic rationality by allowing the market to find the most efficient way of abatement. From an environmental economics perspective, it was the discipline's coming of age: it could now be used to advise on actual policy without forsaking tools and assumptions of mainstream economics.

However, the same qualities that made market-based tools politically acceptable made them open to criticism. Intellectuals from ecological economics and political ecology challenged the appropriateness of commoditizing pollution rights and outsourcing environmental protection to financial markets. Lohmann (2006) posited that trading of emissions shifted the blame and provided room for corporate greenwashing without addressing the structural causation of pollution. Furthermore, permit markets were plagued by over-allocation, price volatility, and regulatory capture—making them less effective on the ground.

These criticisms revealed a fundamental issue: sustainability had been understood by environmental economics as a question of optimizing a problem, not a normative issue of justice, ethics, and ecological integrity. As Faber et al. (1996) explained, because it concentrated on efficiency and marginal thinking, environmental economics was a sub-discipline with narrow analytic capabilities, failing to comprehend systemic ecological crises. This reductionist way of posing the question made clear the intellectual horizon at which a richer paradigm—ecological economics—would subsequently develop.

1.2.3. Conclusion: Environmental Economics at a Crossroads

Environmental economics provided key innovations to policy and scholarly analysis by the incorporation of the theory of externalities, encouraging the application of cost-benefit analysis, and the development of market-based environmental tools. Environmental economics enabled policymakers to internalize external costs and to craft rules that balanced efficiency with protection of the environment. National governments and organizations that include the World Bank and OECD came to subscribe heavily to the application of environmental economics to help policy assessment and regulation measures during the

1980s and 1990s.

However, the very success of environmental economics also made its limitations clear. Rooted in neoclassical assumptions, it tended to favor efficiency at the expense of equity, marginal adjustments at the expense of systemic changes, and substitutability at the expense of ecological realism. As Spash (1999) stressed, its emphasis on utilitarian and individualistic paradigms did not allow much room for dealing with questions of intergenerational justice, irreversibility, and intrinsic value of nature. By translating nature into a series of priced services or damages, it ran the risk of overlooking ecological degradation's wider meaning.

These weaknesses became particularly glaring against the backdrop of global ecological crises like biodiversity loss, climate change, and planetary boundaries. Researchers and practitioners began to see that pricing externalities could no longer be expected to address multifaceted socio-ecological issues based on imbalances of power, institutional resistance, and normative disagreement. This led to an increased demand for an integrated way of thinking that would go beyond market rationality and incorporate ecological thinking, ethics, and cross-disciplinary knowledge.

So, the emergence of environmental economics, although a major step forward for bringing nature into the policy fold, eventually laid the groundwork for a far deeper rethink of the economics-environment relationship. The next chapter is devoted to ecological economics—a discipline that arose specifically to surmount the conceptual, methodological, and ethical flaws of its forerunner.

1.3. THE EMERGENCE OF ECOLOGICAL ECONOMICS: A PARADIGM BEYOND EFFICIENCY

By the late 1980s, an increasing number of scholars, policymakers, and activists started to develop a more profound critique toward the neoclassical paradigm for the environment. Even after public policy had widely taken on the application of environmental economics,

there were still questions lingering regarding the discipline's capability for dealing with ecological degradation, justice, and systemic risk. Critics contended that internalizing externalities by pricing did not account for the physical limits of the Earth's ecosystems nor for the ethical aspects of environmentally-based decision-making. It was within the context that ecological economics came to exist—not so much as a branch of economics, but as a separate paradigm that aimed to rethink the relationship between the economy and nature.

The institutional birth of ecological economics is typically traced to the founding of the journal *Ecological Economics* in 1989 by a group of scholars including Robert Costanza, Herman Daly, Charles Perrings, AnnMari Jansson, and others. Their goal was to create a space for transdisciplinary dialogue between economists, ecologists, systems theorists, and philosophers. As Costanza (1989) noted in the journal's inaugural editorial, ecological economics aimed to be “a new transdisciplinary field of study that seeks to integrate the study of humans and their environment in a way that maintains the integrity and sustainability of both” (p. 1). This formulation marked a radical departure from the reductionist tendencies of environmental economics, which treated environmental problems as isolated inefficiencies rather than structural crises.

One of the discipline's initial claims was that the economy is a “subsystem” of the ecological system at large, and not vice versa. This ontological shift had deep implications. It entailed abandoning the assumption of infinite substitutability of humanmade and natural capital, and the acknowledgment that some ecological processes—such as climate regulation, biodiversity, or nutrient cycling—are functionally irreplaceable. Herman Daly, one of the discipline's intellectual founders, promoted a “steady-state economy” with stabilized and bounded biophysical throughput within planetary boundaries. According to him, “the scale of the economic subsystem relative to the biosphere is the key neglected variable in neoclassical theory” (Daly, 1991). Ecological economics challenged the prevailing anthropocentric and utilitarian value structures of mainstream economics as well. Economists like Joan Martinez-Alier and Clive Spash laid a premium on “value pluralism,” contending that money could not value the cultural, ethical, and ecological impor-

tance of ecological goods. This expanded analysis from cost-benefit trade-offs to encompass participatory methods, multi-criteria analysis, and deliberative democracy methods. Ecological economics thereby brought economic analysis back into harmony with the intricacies of actual ecological and social processes.

1.3.1. Core Principles: Strong Sustainability, Irreversibility, and Resilience

At the heart of ecological economics lies a commitment to what scholars term “strong sustainability.” This concept challenges the idea that different forms of capital—natural, human, and manufactured—are fully substitutable. Unlike “weak sustainability,” which allows the depletion of natural capital as long as total capital remains constant, strong sustainability holds that certain ecological functions and resources are non-substitutable and must be preserved intact. As Neumayer (2010) explains, “Strong sustainability assumes the existence of critical natural capital that performs irreplaceable functions for the survival of life on Earth”. This includes ecosystems such as rainforests, wetlands, coral reefs, and atmospheric systems that regulate climate and support biodiversity.

Another constitutive idea is “irreversibility”. Ecological economists point to thermodynamics and theory relating to ecological systems that many changes in the environment—e.g., species loss, forest clearing, or climate tipping—do not only incur costs but are irreversible. Standard costing-benefit models that discount the future find it hard to accommodate such consequences. Georgescu-Roegen’s thermodynamic insights provided the background for seeing economic processes as “entropic”, one-way conversions deteriorating matter and energy. This biophysical realism makes ecological economics inherently hesitant toward over-reliance on technology remedies or price measures alone.

Inextricably linked with irreversibility is the concept of “resilience”—the ability of ecological and social systems to absorb disturbances and reconfigure without falling into a qualitatively different regime. Ecological economics, based on the research of C.S. Holling and other scholars, incorporates the concept of resilience to evaluate how economies adjust to ecological perturbations without reaching critical thresholds of

regime shift. This is in dramatic contrast with neoclassical models, which tend to take equilibrium and constant adjustments for granted, usually not considering systemic feedback loops, path dependence, and uncertainty.

In addition, ecological economists stress the application of the "precautionary principle": when there exists serious or irreversible damage, scientific uncertainty should not be a justification for delaying preventive action. This is an established principle in environmental law that is contrary to the risk-neutral assumptions that underlie cost-benefit analysis. This is a wider ethical perspective within ecological economics: that sustainability is not a question of efficiency, but of preserving the context for life and justice in the future. Combining these principles, ecological economics recasts the purposes of economic activity. Rather than optimizing output or utility, it aims to ensure ecological integrity and stability of the system on Earth, distributive fairness, and democratic control over those who make choices that have impacts on the environment and human welfare.

1.3.2. Methodological Pluralism and Institutional Innovation

One hallmark of ecological economics is its methodological pluralism. As opposed to neoclassical economics with its over-reliance on mathematical modeling and equilibrium analysis, ecological economics borrows from a broad spectrum of disciplines and methodologies—such as systems ecology, political economics, ethics, and participatory research. This is a matter of a basic philosophical commitment to epistemic humility: the humility to know that there is no one method that is able to fully encompass the complexity of human-environment relations.

In terms of policy implementation, it has resulted in the use of multi-criteria decision analysis (MCDA), deliberative appraisal, and stakeholder-based scenario thinking. These tools enable the incorporation of different perspectives, other than monetary ones, and long-term visions that are usually marginalized within cost-benefit appraisal schemes. As Martínez-Alier et al. (1998) put it, ecological economics is interested in "conflicting values, equity, and uncertainty—dimensions that are routinely ignored by standard economic

analysis”.

In terms of policy, ecological economists have proposed alternative paradigms to inform sustainable development policymaking. These include the ”safe operating space” rationale associated with planetary boundaries (Rockström et al., 2009), the ”doughnut economics” approach promulgated by Raworth (2017), and the ”scale, distribution, and allocation” trio by Daly. These suggestions redefine policy ends from simple growth to ”biophysical feasibility, social justice, and economic sufficiency”. They prioritize institutions that honor ecological boundaries, curb inequalities, and green environmental governance.

In addition, ecological economics has called into question the paramount position of ”Gross Domestic Product (GDP)” as a welfare indicator. Scholars from the discipline call for new measures like the ”Genuine Progress Indicator (GPI)”, ”Index of Sustainable Economic Welfare (ISEW)”, and ”Inclusive Wealth Index (IWI)”, which add considerations of the degradation of the environment, the value of unpaid work, and income distribution to accounts of well-being. These measures seek to align policy incentives with sustainability by transcending the fallacy that growth is always associated with welfare improvement.

Institutionally, ecological economics has influenced international discussions on sustainable development, ranging from the Earth Summit at Rio (1992) and Agenda 21 to the United Nations’ SDGs. Although still on the periphery of mainstream economics departments, it has made some appearances at interdisciplinary sites, especially within European and Latin American contexts, where post-growth and ecojustice discourses are more active.

1.3.3. Conclusion: Ecological Economics as a Normative and Scientific Shift

Ecological economics is not only a scientific critique of neoclassical environmental philosophy, but a highly normative enterprise as well. It invites economists to rethink the ends, assumptions, and ethical underpinnings of their profession. Whereas environmental economics tries to maximize within given institutional settings, ecological economics

raises more fundamental questions: What is the economy for? How do we relate to nature? What are our obligations to future peoples and to other forms of life?

Such questions cannot be solved with efficiency calculations only. They call for ethical consideration, historical literacy, and ecological literacy. Ecological economics thus presents itself at once as a critique and a reconstruction of economics. It attempts to bridge the dualisms of economy and ecology, fact and value, human and non-human—pursuing an integrated view of sustainability based on interdependence, precaution, and justice.

In spite of its mounting power, ecological economics still suffers from institutional resistance. It questions growth-based macroeconomic models, challenges mainstream measures of progress, and demands systemic change—all of which go against vested interests and disciplinary tradition. But its basic insights have started to shape large policy spaces and international agendas, especially those trying to connect development and environmental sustainability.

This thesis engages with the emergence of ecological economics not as a mere scholarly novelty, but as a necessary intervention into the history of economics as a discipline. The second part of the thesis engages with a quantitative look at the evolution of some of the most important concepts from ecological and environmental economics and their representation (or lack thereof) within international development policy—particularly within the United Nations Development Programme's Human Development Reports.

CHAPTER 2

LITERATURE REVIEW

This chapter provides a structured review of the conceptual and institutional evolution of environmental and ecological economics, with the goal of clarifying their points of convergence and divergence. Both paradigms came into being due to the inadequacies of neo-classical economics to explain the degradation of the environment, but they have trended ever more differently. Environmental economics, based firmly on utilitarian reason and marginal analysis, has become widely applied to policy by way of cost-benefit analysis and market-based measures. Ecological economics, however, calls for a paradigm based on systemic thinking, biophysical constraints, and ethical pluralism.

This comparative literature review is motivated by a deficiency that exists within current research: although both strands of research are widely referenced within the context of sustainability, limited research provides a systematic explanation for how their competing assumptions find expression in alternative valuations, risk perspectives, policy design, and moral standards. Additionally, the world development literature infrequently explains which paradigm is the foundation of important measures of sustainability, such as those applied within HDRs.

In response, the chapter follows a four-part sequence. It is initiated with a series of histories of the emergence and institutionalization of each branch of sustainability research. It goes on to contrast their visions of sustainability, focusing on the weak vs. strong sustainability debate. The subsequent section charts primary regions of overlap and divergence, from methods of evaluation to political ethics. Lastly, it examines the extent to which each paradigm has influenced world policy regimes—particularly HDRs—through selective adoption of concepts and unresolved structural tensions within governance for

sustainability.

2.1. HISTORICAL EVOLUTION OF ENVIRONMENTAL AND ECOLOGICAL ECONOMICS

Exploring the evolution of the ecological and environmental economics tradition needs careful decoupling of their intellectual origins, institutional consolidation, and methodological evolution over time. While both appeared in reaction to mounting evidence on the scale of ecological crises and the inadequacies of orthodox economics, their paths forked quite decisively at the levels of scale, epistemology, and normative bias. This section chronicles the development of both paradigms by reviewing milestones within the academic record, turning point theories, and the processes behind their institutionalization within the wider economics tradition.

Environmental economics emerged earlier within a scholarly context, particularly within the Anglo-American world from the 1960s and 1970s. The discipline developed on the basis of the early concepts of Pigou and Coase, with the issue of market failure due to adverse externalities being the focal point around which it coalesced. Postwar times had seen rapid industrialization and perceptible pollution crises, where there was thus a public call and policy room for applied economics to consider issues of the environment. A turning point came with the publication of Baumol and Oates' *The Theory of Environmental Policy* in 1975. They formalized the use of neoclassical techniques to control pollution and management of natural resources, and contended that “appropriate pricing and regulation could lead to efficient environmental outcomes without sacrificing economic performance” (Baumol & Oates). They provided a foundation for the later dominance of cost-benefit analysis and market mechanisms in the management of the environment.

Concurrent with neoclassical growth theory came the integration of environmental considerations within economics as a sub-discipline—highlighted by the rule of Harold Hotelling on the depletion of resources (1931). Economists like Partha Dasgupta, Geoffrey Heal, and Robert Solow made attempts at integrating and optimizing intertempo-

ral models with both renewable and non-renewable resources. This led to formalizing “green accounting” and the World Bank’s Adjusted Net Savings method that sought to define sustainability as sustaining the overall stock of capital. Integration notwithstanding, critics raised the argument that rational agent assumptions, substitutability, and equilibrium hid ecological and social realities that underlay them. By contrast, ecological economics emerged later and more contentiously. Its intellectual roots stretch back to the 1970s—particularly with the publication of Georgescu-Roegen’s *The Entropy Law and the Economic Process* (1971)—but its institutional consolidation came only in the late 1980s. Unlike environmental economics, which largely retained the neoclassical framework, ecological economics rejected core economic assumptions in favor of thermodynamic realism, systems thinking, and normative pluralism. The founding of the International Society for Ecological Economics (ISEE) in 1988 and the launch of the journal *Ecological Economics* in 1989 marked the formal birth of the field. As Daly (1996) emphasized, ecological economics “seeks to ground economic analysis in the biophysical laws of nature, rather than in the axioms of utility maximization and market equilibrium”.

What distinguished ecological economics was its ambitions to be transdisciplinary—exceeding the application of economics to the environment by questioning the ontology and ethics of the economy itself. Sources came not just from economics, but also from ecology (Odum, Holling), systems theory (Meadows, Forrester), ethics (Norton, Sagoff), and political economy. This heterogeneity yielded a richer but also more subversive discipline—willing to take on issues like degrowth, justice for the environment, and the limits to growth paradigm at a time when mainstream economics was preoccupied with efficiency and piecemeal reform.

2.1.1. Institutional Growth and Thematic Expansion

In the 1990s and 2000s, ecological and environmental economics intensified their scholarly and policy profile, although along more and more separate trajectories. Environmental economics gained a strong foothold within mainstream economics departments, international institutions, and governmental regulation authorities. Top economics jour-

nals started to publish special issues on environmental valuation, and the World Bank and OECD were some of the main agencies to adopt environmentally based cost-benefit methods for project appraisal and development planning. Universities in North America and Europe started to introduce modules on environmental economics within traditional economics curricula and focusing on technical policy analysis, econometrics, and market-based tools.

However, during this time, economics began to align with the "climate policy agenda", especially after the establishment of the Intergovernmental Panel on Climate Change (IPCC) and the signing of the Kyoto Protocol (1997). Economists like William Nordhaus also constructed integrated assessment models (IAMs) like DICE and RICE to assess the economic costs of climate change and inform the policy of mitigating it. IAMs gained prominence for informing global climate negotiations, although it has been argued that they minimized catastrophic risks and used contentious discount of future damages (Pindyck, 2013).

In contrast, ecological economics proceeded along a more inter- and somewhat activist path. It became a scholarly home for those who were unhappy with the narrow growth-orientation and utilitarianism of neoclassical models. Thematic streams like "environmental justice", "energy descent", "circular economy", "ecosystem services", and "degrowth" became mainstream within ecological economics. Organizations like the European Society for Ecological Economics (ESEE) and networks based in Latin America focused on connections with postcolonial theory, indigenous knowledge, feminist economics, and the commons.

Ecological economics was also prominent in the design of alternative indicators. While environmental economists did research "green GDP" and satellite accounts, ecological economists aimed for much more fundamental deviations, such as the "Genuine Progress Indicator (GPI)" and the "Happy Planet Index (HPI)". These indexes abandoned growth of GDP as welfare measurement and attempted to couple ecological sustainability, human welfare, and equity into aggregative measures. They were often developed with civil soci-

ety groups and sub-national governments, particularly within Europe and Latin America. As time went on, the institutional and methodological difference between both streams became even clearer. Environmental economics had a positivist and model-based orientation with a goal of policyrelevant refinement based on technique. Ecological economics accommodated normative involvement, epistemic pluralism, and a focus on examining growth and even on capitalism critically. As Vatn (2005) put it, “The difference is not only about methods, but about the goals of science, the choice of relevant questions, and the role of values in economic analysis”.

2.1.2. From Efficiency Paradoxes to Thermodynamic Constraints: Jevons, Boulding, and Georgescu-Roegen

In the latter half of the nineteenth century, concern with the scarcity of resources grew with the advent of industrial energy systems. William Stanley Jevons, writing in his classic text *The Coal Question* (1865), introduced a paradoxical but penetrating observation: that making the use of energy more efficient is not necessarily a form of saving but may indeed hasten exhaustion. This effect, subsequently named the *Jevons Paradox*, implied that enhancements in the efficiency of using coal led to making it economically sensible to increase the use of coal, rather than decrease it. Jevons contended, “It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to diminished consumption. The very contrary is the truth” (Jevons, 1865). His observation refuted the optimism in technology fixes and brought forth the rebound effects that come with capitalist production methods. This reluctance to accept unlimited substitution of natural capital has surfaced again more strongly during the twentieth century with the writings of figures like Kenneth Boulding and Nicholas Georgescu-Roegen. Boulding’s (1966) classic article, *The Economics of the Coming Spaceship Earth*, compared two metaphors for “economy”: the “cowboy economy” of open-frontier exploitation and the “spaceship economy” of closed systems and limited resources. He argued that economics needs to transform from the logic of maximizing throughput to one of maintaining, sustaining, and equilibration within the system. As Boulding put it, “Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist” (Boulding,

1966). His critique heralded other ecological economics issues about throughput, entropy, and sustainability.

Perhaps the most theoretically formative challenge to neoclassical presuppositions came from Nicholas Georgescu-Roegen, whose work incorporated thermodynamic constraints into economic thinking. In *The Entropy Law and the Economic Process* (1971), Georgescu-Roegen contended that economic activity is circumscribed by the Second Law of Thermodynamics—irreversible growth of entropy with each transformation. Condemning the assumption that natural capital could be perpetually supplanted by human-capital, he contended that neoclassical economics rested on “a gross misrepresentation of physical reality” (Georgescu-Roegen, 1971,). His insistence on a “bioeconomics” based on the physical laws of energy degradation deviated dramatically from both classical and neoclassical conventions.

Georgescu-Roegen’s writings were largely overlooked by orthodox economists but came to form the basis of ecological economics during the 1980s and 1990s. His application of ecological science and thermodynamics to economic theory brought a scientifically grounded, biophysical critique of the growth paradigm for economics. These ideas explicitly debunked the assumption of perpetual expansion within economics and legitimated demands for a steady-state or even a “degrowth” paradigm.

Collectively, Jevons’ contributions, along with those of Boulding and Georgescu-Roegen, transmitted a mounting discomfort with economic abstractions from physical and ecological facts. They supplied an important intellectual bridge from the classical awareness of scarcity of resources to a contemporary, cross-disciplinary challenge to infinite growth assumptions. Their contributions led the way for both for environmental economics—attempting to internalize costs of the environment—and ecological economics, which challenged the growth-centric world view on its fundamental assumptions

2.1.3. Conclusion: Two Fields, Two Visions

The historical evolution of environmental and ecological economics illustrates two distinct yet overlapping responses to the environmental crises of the twentieth and twenty-first centuries. Environmental economics, emerging earlier and rooted in neoclassical frameworks, sought to correct market failures using the familiar tools of price theory, regulation, and optimization. It gained some purchase with large institutions, policy formulation, and low-cost regulation of the environment, particularly where quantification and efficiency had a political and technical priority.

Ecological economics came later and as a response to the perceived weaknesses of neoclassical economics. It challenged the simplification of ecological issues to pricing challenges and presented a systems-based, ethically grounded view of sustainability that focuses on biophysical boundaries, social justice, and long-term durability. It focused on thermodynamic concepts, value pluralism, and institutional evolution to challenge mainstream economics' prevailing paradigm and suggest avenues for new forms of transdisciplinary research and civic activism.

Collectively, they embody different paradigms not only methodologically, but also in their visions of progress. One views sustainability as an issue of optimizing and allocating resources; the other, as a matter of scale, justice, and planetary boundaries. Their split explains why there is a persistent tension within sustainability policy and discussions—most visibly when development agendas seek to reconcile economics with ecological integrity.

As we move on to the next subsection, we shall be examining further how these contradictory paradigms influence the "theoretical and practical comprehension of sustainability"—particularly within the arguments over substitutability, carrying capacity, and resilience. These terms not only establish the dichotomy of weak and strong sustainability but also serve as the foundation for assessing the extent to which main world development paradigms, e.g., the Human Development Reports, have incorporated ecological thinking.

2.2. SUSTAINABILITY PERSPECTIVES: SUBSTITUTABILITY, RESILIENCE, AND CARRYING CAPACITY

The discourse on sustainability has been deeply influenced by the assumptions present within the economics paradigms that are involved with issues of the environment. At the heart of the disconnection is the question of whether natural capital—ecosystems, resources, and services that sustain life—can be substituted meaningfully with humanmade capital. This is usually conceived as a matter of “weak” versus “strong” sustainability and signifies a tension at the root of environmental and ecological economics.

In the context of environmental economics, “weak sustainability” is the idea that so long as aggregate capital stock—made up of natural, human, and manufactured capital—does not fall, sustainability is ensured. It is based on neoclassical growth theory, where inter-generational fairness is derived from being able to pass on equivalent consumption levels to the next generation. As Pearce and Atkinson (1993) suggest, “development is sustainable if future generations’ well-being is not poorer than that of present generations, which may be guaranteed by a non-declining stock of capital”. Technological progress, learning, and investing are, in this view, able to make up for environmental degradation.

In contrast, ecological economics embraces “strong sustainability”, which asserts that there is some natural capital that is non-substitutable and needs to be left intact. These “critical natural capitals” are those involving biodiversity, atmospheric stability, and hydrological cycles—functions that cannot be substituted for using technology or money. As Ekins et al. (2003) contend, strong sustainability demands “that certain environment functions need to be provided because their degradation would be irreversible, or because they are crucial to Earth system operation” (p. 168). This is based on recognition of biophysical constraints and the precautionary principle, defying the assumption of complete substitutability. Another ecological sustainability key concept is “carrying capacity”—the maximum size of population or consumption level that a specific ecosystem may sustain forever. Ecological economics focuses on the fact that economies have to be run within the ecological limits of the regenerative capacity of Earth. Non-adherence to carrying

capacity results in overshoot and degradation, as has been brought to light by the “limits to growth” literature (Meadows et al., 1972). Environmental economics, on the other hand, views environmental limitations as constraints to be optimized against, hoping that market signals and adjustment regulation may avert collapse.

This difference becomes especially relevant when dealing with sophisticated planetary issues such as climate change or loss of biodiversity. Environmental economics uses “integrated assessment models” (IAMs) as a norm to computerize climate paths and analyze policies for limiting climate change using benefit-cost analysis. Critics suggest that IAMs underrate uncertainty, discount for catastrophic events, and simplify ecological feedbacks. Ecological economics counters with a call for “resilience thinking”—science that focuses on stability, flexibility, and shock absorption without loss of function of the system.

2.2.1. Precaution, Discounting, and Intergenerational Equity

A crucial divergence in terms of how each discipline thinks about risk, uncertainty, and ethics involving future generations is present between ecological economics and environmental economics. Environmental economics generally subscribes to a model of intertemporal optimizing based on the use of “discounting” to convert future costs and benefits into present values. The application reflects individual time preference as well as opportunity costs of capital, enabling the efficient temporal scheduling of environmental policies. The consequence is that environmental damages far into the future—such as sea levels rising or a collapse of biodiversity—tend to get low present value in policy appraisals, which contributes to a delay of action.

This method has come under strong criticism, particularly when applied to climate change. As Stern (2006) contended in his groundbreaking report, “The case for strong early action on climate change is fundamentally an ethical one, not simply a matter of efficient investment”. Stern applied a far lower discount rate than other economic appraisals, focusing on the “moral weight of intergenerational impacts”. His departure from traditional economic assumptions revived arguments on whether traditional tools such as

discounting were applicable to addressing long-term, irreparable environmental loss.

Conversely, ecological economics generally rejects the habitual application of discounting for long-term ecological concerns. Ecological economics promotes the "precautionary principle"—the view that scientific uncertainty is no reason for delay when there is a risk of serious or irreversible damage. This approach is based on a different risk philosophy from optimizing based on known constraints: instead, precaution is focused on systemic vulnerability, uncertainty, and the potential for irreversibility and tipping points. As O’Riordan and Jordan (1995) put it, “Precaution is about being watchful in the light of incomplete knowledge, and preferring those measures which sidestep unacceptable consequences”.

Ecological economics recasts “intergenerational equity” as a moral imperative to maintain the integrity of Earth’s life-support systems rather than an issue of capital maintenance as a technical problem. Ecological economics borrows from the fields of ethics, ecology, and legal theory to argue that future generations have rights that cannot be framed in terms of utility functions or market preference. As Norton (2005) states, “Intergenerational obligations cannot be discharged through market mechanisms alone—they require a broader civic and ethical framework that transcends presentist cost-benefit logic”. The difference also illustrates different perspectives toward control and predictability. Environmental economics is based on modeling the systems as being controllable with carefully calibrated policy aimed at optimizing outcomes. Ecological economics takes its cues from complexity theory and the science of resilience and models socio-ecological systems as being uncertain and non-linear. This translates into policy that is adaptive, participatory, and respectful of ecological constraints.

2.2.2. Resilience, Thresholds, and Systemic Thinking

Another fundamental distinction between environmental and ecological economics is that they have different assumptions regarding dynamics of the system. Environmental economics hinges on equilibrium models based on the assumption that economies and

ecosystems are drawn toward stability and that they could be coaxed back toward balance using suitable incentives. Market-based measures of the form of carbon pricing or permit trading are predicated on agents behaving predictably and on the assumption that markets return to optimal trajectories after small deviations from them.

Ecological economics, on the other hand, builds heavily on "resilience theory" and "complex systems science". These models highlight that socio-ecological systems are not self-correcting or linear. Instead, they are dynamic, history-dependent, and vulnerable to sudden and irreversible regime shifts. The term "resilience"—introduced by C.S. Holling back in 1973—refers to a system's shock-absorbing and adapting capabilities without exceeding those critical points that lead to a drastically different state. A forest ecosystem, for instance, is capable of recovering from cyclic fire, but after some point, deforestation or climate stress could push it into irreversible savanna or desert states.

Ecological economists use these observations to make the point that sustainability policy needs to take into consideration "threshold effects", "feedback loops", and "irreversibility". Cost-benefit analyses based on steady states and marginal changes, which tacitly assume continuity, tend to be insensitive to these nonlinear dynamics. Perrings (2006) observes that "resilience thinking changes the point of view from optimal states to safe operating spaces where systems keep their identity and functionality".

This systems view also transforms our interpretation of "adaptive management". No longer do we look for optimal fixed policies, as ecological economics proposes flexible, cyclical strategies that should be able to react to new knowledge and changing circumstances. Uncertainty calls for strong methods—ones that do not necessarily maximize utility within a tightly specific model, but do a decent job across a broad spectrum of cases. Scenario planning, multi-criteria decision analysis, and participatory governance are thus favored over rigid cost-benefit analysis. In addition, resilient thinking is skeptical of "technological optimism" that pervades much of the economics of the environment. Economists tend to take it as a given that innovation would overcome environmental limitations, whereas ecological economics is wary that technological remedies could create

new dependencies or unintended effects. This reflects the “rebound effect” which Jevons (1865) documented, where higher efficiency translates into higher consumption of resources and not savings. On that basis, sustainability is not a question of substitutability with technology, but of preserving the functional integrity of the life-support systems on Earth.

2.2.3. Conclusion: Framing Sustainability for the 21st Century

The conceptual divide between weak and strong sustainability captures a broader rift in how economics engages with the challenge of long-term ecological and social well-being. Neoclassical-based environmental economics sees sustainability as a matter of optimizing—something that may be resolved by price adjustments, externalities correction, and investments in capital that is substitutable for one another. Its tools favor efficiency, predictability, and the preservation of consumption options over time.

Ecological economics sees sustainability as a question of respecting biophysical constraints, saving key natural assets, and promoting justice across species and time. It seeks precaution rather than prediction, resilience rather than equilibrium, and plural values rather than monetary standards. Sustainability from this lens is not a question of taking the most efficient route within current ways of organizing, but rather of revising goals, institutions, and ethical premises of economic life.

These alternative views have explicit consequences for world development policy. Weak sustainability has influenced mainstream development models like the World Bank’s “wealth accounting,” which quantifies sustainability in terms of stock aggregates of capital. Strong sustainability, although less entrenched institutionally, has influenced alternative measures like the Ecological Footprint, the Planetary Boundaries method, and the Genuine Progress Indicator—substantives that attempt to quantify whether human activity is within ecological limits.

Our definition of sustainability affects not only which policies are implemented, but which futures are envisioned. A weak sustainability vision might be compatible with

green growth, eco-efficiency, and market-based measures; a strong sustainability vision might call for more fundamental changes—towards degrowth, redistribution, and ecological democracy.

In the section that follows, we contrast where the perspectives of ecological and environmental economics overlap and differ along these and other dimensions. By plotting their common issues and unique logics, we better see the tensions, and opportunities, involved when sustainability is construed under competing economic perspectives.

2.3. POINTS OF CONVERGENCE AND DIVERGENCE

In common with each other and notwithstanding their methodological and philosophical differences, ecological and environmental economics share some common intellectual heritage and a number of converging concerns. Both disciplines found their origins in a response to the insufficiency of mainstream economic models to explain ecological degradation, and both attempt to bring ecological reality back into economic analysis. Nevertheless, each has quite different ways of framing issues, selecting tools for analysis, and formulating policy measures.

One area of overlap is recognition of "limits to the environment". Both paradigms dispense with the unthinking assumption of unending economic growth that typified postwar neoclassical models. Environmental economics acknowledges that there is a necessity to internalize externalities and manage natural resource limitations on growth patterns. Ecological economics shares the view that the fiscal mechanisms of the economy have to stay within the regenerative capabilities of the ecosphere. The former may find themselves pricing carbon to help reduce greenhouse gas emissions, while the latter may insist on biophysical caps as a condition to economic planning.

Another common concern is that there is a necessity to go "beyond GDP as a measure of well-being". Ecological economics has facilitated the development of "green GDP," adjusted net saving, and natural capital accounting measures to record environmentally

induced depreciation in national accounts. Ecological economics takes the issue further, formulating alternative measures like the Genuine Progress Indicator (GPI), Ecological Footprint, and Happy Planet Index that take into account well-being, equity, and ecological integrity. They are both consistent that GDP is a bad indicator of societal progress even though they have different proposals for a replacement.

Both fields have cooperated on the design of "policy instruments" to tackle pollution and overuse of resources, specifically with the development of environmental taxes, tradable permits, and payment for ecosystem services programs. Environmental economists tend to rationalize such tools based on efficiency and marginal abatement costs, whereas ecological economists tend to assess them based on ecological performance, justice, and institutional design. Nonetheless, let nothing be said to overrule the deep differences that obtain between them. The most basic distinction is their "ontological assumptions". Environmental economics considers the environment as an "external sector" that could be absorbed into the economic sphere through appraisal and regulation. Ecological economics conceives of the economy as a subsystem within the biosphere, bound by the laws of thermodynamics and ecological limitations. This switch of perspective translates into diverse priorities, criteria for policy, and normative regimes.

2.3.1. Valuation, Uncertainty, and Analytical Tools

The divergence in valuation methods says a lot about the underlying philosophical commitments of each discipline. Environmental economics depends very much on "monetary valuation", with methods based on contingent valuation, hedonic pricing, and revealed preference to estimate the monetary value of non-market goods. These methods rest on the foundation of welfare economics and take the assumption that individual preferences, when collectively combined, can be a surrogate for social value. This makes it possible to accommodate environmental goods within "cost-benefit analysis", which is still the prevalent tool for policy appraisal within many national and international institutions.

Ecological economics, on the other hand, rejects the translation of environmental value

into monetary terms, especially with regard to "intrinsically valuable or culturally embedded ecosystems". Ecological economics embraces "value pluralism"—identifying ethical, cultural, religious, and ecological components that cannot be easily balanced against each other. Techniques like "multi-criteria analysis", "deliberative valuation", and "participatory budgeting" are favored to accommodate plural perspectives from diverse sets of stakeholders and to deal with incommensurable trade-offs. As O'Neill (1993) asserts, "Pluralism in values demands pluralism in methods" caution against price-based hegemonic choice in democracies.

Another difference of perspective is the way each discipline deals with "uncertainty and risk". Environmental economics generally uses probabilistic modeling and sensitivity analysis on the assumption that risk is measurable and controllable by statistical methods. Uncertainty is viewed as an issue of "information asymmetry" or insufficient data. Ecological economics, on the other hand, acknowledges "deep uncertainty"—cases where outcomes are unknown or unknowable because of the complexity of the system, feedback loops, and tipping points. When that is the situation, it prefers the "precautionary principle", "scenario planning", and "adaptive management", with a recognition of prediction limitations.

Such differences shape the types of "recommendations for policy" each discipline makes. Thus, to tackle climate change, for instance, environmental economists would suggest "carbon taxes" that are tapered to marginal estimates of damages. Ecological economists, on the other hand, might suggest "hard caps" on emissions, "decentralized energy", and "declining material throughput", regardless of exact monetary valuations. While the former propagates solutions that are "cost-saving" within established economics, the latter is likely to advocate for structural reform and ethical reinterpretation. Notably, there are not only methodological differences here—they represent different visions of what economics is and how it is to serve society. The one is optimizing within a growth-compatible regime; the other is optimizing for sufficiency, justice, and ecological constraint.

2.3.2. Ethics, Justice, and the Politics of Sustainability

Apart from technical techniques and modeling assumptions, one of the most profound differences between ecological and environmental economics is their "ethical orientation". Whilst environmental economics has a largely utilitarian ethical basis, where policies are judged by their aggregations of individual preference and their impacts on welfare at society level, value is instrumental—i.e., derivative from a good/service being able to fulfill human desire. This allows for explicit trade-offs but easily marginalizes issues of "intrinsic value", rights for other than human agents, and moral duties lying outside market rationality.

Ecological economics resists this utilitarian basis by promoting "intrinsic and relational values" of the natural world. Ecological economics takes inspiration from environmental ethics, deep ecology, and systemic thinking to hold that nature is worthy of respect for its own sake—not just for what it contributes to humanity—since it is a co-constituent of life and moral community. The notion of "the rights of nature", which has become incorporated into legal codes of states such as Ecuador and New Zealand, is consistent with the ecological economics perspective. This way of thinking allows for "ecocentric policy regimes", wherein the preservation of the integrity of ecosystems is not dependent on their human value.

The notion of "justice across generations" also betrays conflicting commitments at a deep philosophical level. Environmental economics is likely to explain future generations' welfare in terms of opportunities for consumption, on the assumption that utility can be transferred from the past to the future via investments and technology improvement. Ecological economics contends that future persons have "the rights to a healthy and functional biosphere", not simply rights to equivalent capital stock. It claims some environmental assets—perhaps genetic diversity or a habitable climate—are "irreplaceable and non-negotiable" regardless of current willingness to pay.

In addition, ecological economics engages "power, inequality, and environmental justice"

explicitly. Ecological economics asks questions about who decides, whose values are supposed to matter, and who suffers the costs and enjoys the benefits of environmental policymaking. This political economy is usually missing from environmental economics, which deals with given tastes and takes no account of structural inequalities. As Martinez-Alier (2002) states, “Environmental conflicts are often conflicts of valuation—between the languages of money and the languages of livelihood, identity, and sacredness”. This highlights the necessity for deliberative and participatory processes that transcend technocratic optimization. Ethical differences find their expression in a “radically different visions of sustainability”. Environmental economics might pursue the most efficient route to a low-carbon economy, while ecological economics asks if an economy based on growth, profit, and commodification is ever sustainable at all. Ecological economics, then, is not so much presenting alternative tools as a “different purpose” for economics in the first place.

2.3.3. Conclusion: Mapping Paradigmatic Boundaries and Bridges

The preceding analysis has established that although ecological and environmental economics have shared concerns regarding ecological degradation, they differ widely on assumptions, methodologies, and normative commitments. These differences are not abstract—they inform policy design, institutional harmonization, and sustainability narratives at large embraced by governments, development organizations, and civil society.

To summarize their contrasting features:

- **Ontological framing:** Environmental economics views the environment as external to the economy, subject to integration through pricing. Ecological economics sees the economy as embedded within, and constrained by, the biosphere.
- **Valuation:** Environmental economics favors monetary valuation and individual preferences; ecological economics adopts value pluralism, ethical reasoning, and participatory methods.

- **Sustainability:** The former subscribes to weak sustainability and substitutability; the latter to strong sustainability and critical natural capital(value).
- **Risk and uncertainty:** Environmental economics relies on optimization and discounting; ecological economics emphasizes precaution, resilience, and deep uncertainty.
- **Policy tools:** Both support environmental taxes and permits, but differ in purpose—efficiency vs. sufficiency and justice.
- **Ethics and politics:** Environmental economics is grounded in utilitarianism; ecological economics in rights-based and ecocentric ethics, with attention to power and equity.

Despite these divergences, some opportunities for convergence have emerged—particularly in the face of global challenges that require pluralistic and cross-disciplinary responses. Hybrid approaches, such as inclusive wealth accounting or the integration of resilience metrics into policy analysis, reflect ongoing efforts to bridge methodological gaps. Though they are not mutually exclusive fields, their tensions are productive: they call for increased questions regarding what sort of economics is compatible with life on Earth being sustained.

Grasping these differences is necessary for assessing the paradigms applied within international development theory—particularly within prominent venues such as the *Human Development Reports* commissioned by the United Nations Development Programme (UNDP). We look in the subsequent subsection at how sustainability theory from each paradigm has—and has not—been incorporated within these prominent reports, and what that indicates regarding the political economy of sustainable development.

2.4. RELEVANCE TO HUMAN DEVELOPMENT REPORTS

The United Nations Development Programme (UNDP) has annually produced the Human Development Reports (HDRs) since 1990, which is one of the most consequential efforts to redefine development from a perspective other than income. With the presentation of the Human Development Index (HDI) and putting well-being, education, and healthcare at the forefront of measures of world progress, the HDRs challenged development thinking focused on GDP. Although the inclusion of environmental issues—most especially sustainability—has proceeded at a slow and patchy rate over time,

Both ecological economics and environmental economics have made their contribution to concepts that shape HDR accounts, although to different extents. Environmental economics vocabulary was seen at the beginning with the use of "natural resource management", "pollution control", and "internalization of environment costs". "Environmental externalities," "sustainable consumption," and "green GDP" were some of the concepts that appeared most clearly, aligned with policy tools based on valuation, pricing, and regulation efficiency.

For instance, the 1994 and 1998 HDRs used language from environmental economics to evidence arguments favoring internalizing environmental degradation within national accounts. The reports urged better environmental indices and stated that "green accounting" could better indicate the sustainability of growth. This orientation is consistent with the perspective of the discipline of environmental economics that sustainability is possible through better measurement, appraisal, and policy tools consistent with sustained growth.

By way of contrast, the fundamental concepts of ecological economics—namely, "biophysical limits," "strong sustainability," and "embeddedness of the economy within nature"—appeared later explicitly within HDRs. While there has come to be a recognition of planetary boundaries and resilience concerns in recent reports (e.g., HDR 2020 and 2021/22), they tend to be addressed as background risks or constraints to be mitigated, not as intrinsic challenges to economic form or development paradigms.

This is consistent with the wider institutional reluctance to accept fully "strong sustainability". Although the HDRs have used their language of human security, resilience, and planetary health, they remain focused on economic development, innovation, and international competitiveness—objectives that are potentially incompatible with ecological economics' call for sufficiency, degrowth, and redistribution

2.4.1. Paradigmatic Influence Across Selected HDRs

A more careful reading of some of the Human Development Reports indicates differing levels of familiarity with the intellectual work of environmental and ecological economics. Although environmental economics has influenced much of the tools and metrics employed in the HDRs, ecological economics' impact—albeit on the rise—has had a more oblique and disconnected character.

The 2007/2008 HDR, *Fighting Climate Change: Human Solidarity in a Divided World*, was the first to put the environment at the center of the human development agenda. It made explicit use of the language of costs and benefits and referenced the Stern Review, using the economics of climate arguments based on the framework of economic damages from environmental economics. Carbon pricing, mitigation costs curves, and technology investment were at center stage, and they are solutions that go with weak sustainability and neoclassical assumptions.

The 2011 HDR, *Sustainability and Equity: A Better Future for All*, marked a partial shift. It acknowledged the need for intergenerational justice, ecosystem thresholds, and policy integration. The report introduced language associated with ecological economics, such as "planetary boundaries" and "ecological footprints," and cited concepts from the Earth system sciences. However, these were often layered atop a continued commitment to economic growth and technological innovation, without questioning the structural drivers of environmental degradation.

The 2020 HDR, *The Next Frontier: Human Development and the Anthropocene*, was the most ambitious effort to mainstream ecological thinking. It made explicit mention of the

Anthropocene as a humandominated epoch and called for a new definition of progress that is distinct from conventional measures based on economics. It introduced a “Planetary Pressures–Adjusted HDI” that incorporates carbon and material footprints within development measurement. This new development is a sign that there is mounting recognition of the biophysical limitations stressed by ecological economics.

Nonetheless, even in this report, ecological economics remains more of a conceptual reference than a fully integrated framework. The focus remains on “decoupling growth from environmental impact,” rather than interrogating the growth imperative itself. Calls for innovation, green technology, and inclusive markets dominate the policy agenda, leaving systemic change and degrowth considerations outside the mainstream HDR narrative. Such examples indicate that although ecological economics concepts have become discursively more prominent, particularly since 2010, they have not yet had any systemic impacts on the “institutional logic” of development as framed in HDRs. This selective adoption is a wider trend across global sustainability regimes, where ecological messages are recognized rhetorically, but infrequently acted on to transform policy directions.

2.4.2. Tensions Between Development Ambitions and Ecological Realism

The limited uptake of ecological economics by Human Development Reports is a sign of more profound tensions within the development agenda. On the one hand, the HDRs are firmly attached to comprehensive development, human capabilities, and multifaceted well-being—values that are shared with ecological economics’ ethical ambitions. On the other hand, they are wedded to a growth-based paradigm with a focus on economic competitiveness, technology-driven advancement, and international integration. This double commitment presents a conceptual contradiction: how is human development to increase without breaking ecological boundaries?

This stress is especially sharp in low- and middle-income countries, where aspirations for development continue to be focused on poverty eradication, the growth of infrastructure, and industrialization. Given the context, both strong sustainability and degrowth argu-

ments tend to be politically unviable, even normatively unattractive. The HDRs account for this by privileging "eco-efficiency" over material throughput reductions, and "inclusive markets" over transforming the system. They do recognize planetary boundaries, but present them as management challenges—rather than boundaries that compel a recasting of development.

Also, international organisations' institutional rationality tends to prefer "consensus-based policy recommendations", which tends to produce a least-common-denominator definition of sustainability. "Green growth," "nature-based solutions," and "resilience" are terms that are flexible and politically expedient but dangerous to watering down the more fundamental ideas of ecological economics. Biermann and Kim (2020) observe that "the institutional design of global sustainability governance has a tendency to reproduce the status quo by preferring soft norms and incrementalism".

Another hindrance is the metrics themselves. Although the HDRs have progressed far in bringing environmental measures—in the form of indicators like the Planetary Pressures, Adjusted HDI, into their fold, they are still based on compound indices that blend ecological achievement with conventional development measures. This bringing together, for the sake of communication, could potentially hide trade-offs across material welfare and ecological integrity. It also provokes methodological issues regarding "commensurability", a criticism long made by ecological economists. In spite of those constraints, the increased use of ecological language and concepts within recent HDRs promises a "discursive opening", a window of opportunity for better sustainability ideas to come in more forcefully in the future. But for those ideas to become really influential, they have to be not only invoked but help actually form the metrics, objectives, and institutional stories of development planning.

2.4.3. Conclusion: Discursive Recognition Without Paradigmatic Shift

Human Development Reports have themselves transformed their handling of sustainability from initial gestures toward environmental economics to a much wider lexicon involv-

ing ecological risks, planetary boundaries, and resilience. But this has happened more rhetorically than paradigmatically. Environmental economic concepts based on valuation, efficiency, and green growth still predominate the policy discourse, with ecological economics remaining on the margins even as its scholarly status and systemic relevance expand.

This is no surprise. HDRs are politically constructed documents within a global institutional environment with a prioritization on growth, consensus, and technocratic responses. Even when the reports do recognize climate change, loss of biodiversity, and ecological degradation, they infrequently take these recognitions and turn them into recommendations that transform the basic premises of economic development. Thus, the HDRs reproduce the wider dynamics of international sustainability governance: the incorporation of ecological rhetoric without transforming the economics of development.

However, partial integration with ecological economics principles—especially within the 2020 HDR’s planetary pressures-adjusted index—does indicate that institutional evolution is on the cards. The hurdle is one of transition from discursive recognition to analytic incorporation: integrating strong sustainability, systemic feedbacks, and irreplaceable ecological breakpoints into development planning and measurement tools.

This section has established theoretical foundations for analyzing the degree to which ecological and environmental economic paradigms have impacted development discourse at the global scale. Subsequent sections put the methods in place to return to a study of academic scholarship and HDR reports using a reverse reference method in order to trace systematically the adoption of selected concepts of sustainability over time. Through study of citation patterns, keyword use, and connections between concepts, our goal is to expose how ideas make their way into policy at the international scale—and which ideas get left behind.

CHAPTER 3

METHODOLOGY

It determines the interpretive stance employed to track the conceptual contribution of ecological and environmental economics to international developmental thinking, above all, within the United Nations Development Programme's *Human Development Reports* (HDRs) from 1990 until now. Avoiding an entirely bibliometric course, the research design is centered on *close textual reading*, *conceptual tracking*, and *manual literature inquiry* to observe how influential ecological-economic thought is implemented, interpreted, or adapted within the HDRs' format.

It serves two purposes: (1) identification and classification of paradigmatic ideas emerging out of ecological and environmental economics, and (2) examination of their rhetorical, strategic, or theoretical usage toward shaping developmental priorities at the global level over time.

To achieve this, the methodology relies on an interpretive-analytical method that combines (i) close reading of HDRs, (ii) conceptual mapping that is steered by keywords, and (iii) literature tracking that triangulates policy applications of concepts with their associated scholarly literature and intellectual histories.

3.1. RESEARCH DESIGN AND OBJECTIVES

This is a qualitative documentary analysis *qualitative documentary analysis design* aimed at uncovering how HDRs have engaged with and reflected core ideas from environmental and environmental economic thought. The approach treats HDRs neither merely as policy reports, but ideologically laced documents that disclose dominant paradigms, changing

norms, and swinging institutional values pertaining to sustainability, nature, and developmental trajectories.

Objectives:

- Recognize and classify significant ideas among HDRs that are similar or borrowed from ecological or environmental economic thought;
- To see how these concepts have progressed and evolved throughout the HDRs over time;
- To link HDR application of such thought with related intellectual debates and theoretical advances in ecological and environmental economics;
- In examining whether and how ecological economics—whether situated institutionally at the margin—has introduced or articulated seminal sustainability framings within the international development discourse.

The study combines policy document analysis with a *manual review of academic literature*, using HDR references as well as broader targeted searches in Web of Science and Google Scholar to uncover foundational and supportive scholarship.

3.2. CORPUS AND SOURCE MATERIALS

3.2.1. Primary Texts: Human Development Reports (1990–Present)

The sample for the analysis is the full text of every HDR published between 1990 and the last report available. Reports are regarded as separate documents and components of the longitudinal data series that represent the UNDP's progressively changing discussion concerning development and sustainability.

Reports are understood thematically and as wholes with detailed attention to:

- Sections or chapters that touch upon ecology, environment, sustainability, climate, or resources; Framing language (e.g., “planetary boundaries”, “green economy”, “
- Diagrams or models that are conceptual and represent ecological or economic structures;
- Direct quotes from economic theories, paradigms, or research articles.

The spreadsheet maintained that documents the *first appearance*, *frequency*, and *contextual framing* of significant ideas and terminology. Some examples of such terminology are the following: “natural capital”, “externalities”, “valuation”, “resilience”, “carrying capacity”, “degrowth”, “planetary boundaries”, “intergenerational equity”, and “inclusive wealth”.

3.2.2. Secondary Literature: Manual Academic Search

Simultaneously with the HDR reading, the *manual literature review of scholarly publications* takes place aiming at exploring:

- The research literature supporting the points included within HDRs;
- The conceptualization of these concepts within environmental or ecological economics;
- Arguments or discussions concerning these concepts by researchers;
- Any direct quotation from HDRs contained in the scholarly literature (reverse citation tracking).

This is done through targeted searches in:

- Web of Science;

- Major journals such as *Ecological Economics*, *Environmental and Resource Economics*, *World Development*, and *Environment and Development Economics*;
- Environment and Edited books and monographs by seminal authors (e.g., Daly, Costanza, Georgescu-Roegen, Martinez-Alier, Arrow, Dasgupta).

All publications and articles are evaluated with reference to their relevancy towards HDR-specific passage or conceptual utilization. Citations are sorted and hand-coded into either “environmental economics-aligned” or “ecological economics-aligned”, depending upon their ontological, epistemological, and normative assumptions.

3.3. ANALYTICAL STRATEGY

Interpretive approach is conceptualized with a three-stage analytical loop:

1. Concept Identification in HDRs

- Reading each HDR to obtain related text;
- Label each mention of crucial sustainability-related terminology;
- Codify each idea for interpretive application (i.e., instrumental, ethical, biophysical).

2. Literature Mapping

- Trace each major idea across seminal and modern scholarly literature;
- Investigate whether HDR usage conforms to the original theoretical foundation or diverges from it;
- Use citation trails, thematic tags, and conceptual frameworks to understand the shift.

3. Interpretation and Comparative Framing

- Comparison of usage of concepts over time and between HDRs;
- Identify trends in convergence or divergence between policy framings;
- Determine whether the ecological economics frame is evident, diluted, or absent.

3.4. SCOPE AND LIMITATIONS

Such an interpretive stance is enriching and enlightening but has several limitations:

- **Laborious Nature of Work:** The reading work of reports and scholarly writings is laborious and susceptible to human interpretive finitude;
- **Selective Corpus:** This study only contains HDRs and does not include other UN policy documents except when they are cited by HDRs;
- **Non-explicit Attribution:** Most of the concepts could be employed without explicit citation, which makes it hard to attach them to given academic paradigms;
- **Interpretive Bias:** The personal model of the researcher may influence the conclusions. This is addressed by maintaining rigorous note-keeping, triangulation, and transparent classification.

Despite these limitations, the thesis's methodology is suitable for the research goal objectives: determining the intellectual traditions and paradigm debates shaping global sustainability discourse, and examining the role played by ecological economics within international policy terminology and frameworks.

CHAPTER 4

FINDINGS AND ANALYSIS

This chapter looks at environmental and ecological economics' paradigmatic and conceptual influence upon discourses of sustainability at the international level with particular emphasis upon the United Nations Development Programme's (UNDP) *Human Development Reports* (HDRs). Preliminary theoretical results and prior literature have distinct predictions regarding influential concepts, scholars, and thematic directions. There have emerged two distinct paradigms within economics—environmental and ecological economics—each with distinct methodologies and moral obligations that have deeply influenced international policy regarding sustainability and storytelling (Costanza, 1989; Daly, 1996; Martinez-Alier, 2002; Raworth, 2017).

Environmental economics triumphed initially due to the availability of market instruments with which it could coexist harmoniously with existing institutional arrangements (Pearce & Atkinson, 1993; Solow, 1991). Ecological economics more recently has shaped policy agendas by emphasizing biophysical limits, deeper sustainability, ethical diversity, and systemic robustness (Rockström et al., 2009; Spash, 2012; Steffen et al., 2015). In considering these introductory remarks, the following sections outline future conceptual and paradigmatic changes preparatory to an extensive empirical survey of their influence upon the HDRs.

4.1. PARADIGMATIC SHIFTS IN SUSTAINABILITY DISCOURSES: FROM MARKET EFFICIENCY TO ECOLOGICAL REALISM

This chapter intends to introduce and discuss the paradigmatic impacts of environmental and ecological economics upon sustainability discourses at the global level with specific reference to their reflections within HDRs. Although detailed quantitative results from the analysis by way of bibliometrics are still forthcoming with the ongoing studies, preliminary hopes that have emerged from the literature available, theoretical exposition, and qualitative observations are emphasized.

Since the 1980s, the intensification of environmental crises—such as climate change, biodiversity loss, resource depletion, and pollution—has sparked debates within economics about addressing these complex challenges (Costanza, 1989; Daly, 1991; Martinez-Alier, 2002). Two prominent paradigms emerged in response: environmental economics and ecological economics (Pearce, Markandya, & Barbier, 1989; Daly, 1996). Environmental economics maintains close ties with neoclassical economics, emphasizing market-based solutions, internalizing externalities, and marginal valuation (Nordhaus, 1992; Pearce & Atkinson, 1993; Solow, 1991). Ecological economics, conversely, arose explicitly as a critique of conventional economic paradigms, emphasizing biophysical limits, strong sustainability, entropy, and ethical pluralism (Daly, 1996; Georgescu-Roegen, 1971; Spash, 2012).

Early observations suggest environmental economics exerted higher influence on global sustainability policy initially due to compatibility with existing institutions and approaches, such as cost-benefit analysis, green GDP, and trading instruments for emissions (Nordhaus, 1992; Pearce et al., 1989). Renowned researchers like Nordhaus, Pigou, and Coase framed international policy discourses by providing market-compatible instruments and policy measures for environmental externalities (Baumol & Oates, 1988; Pigou, 1920; Coase, 1960).

However, most recent theoretical efforts and qualitative syntheses mirror that ecological economics has increasingly become part of the mainstream sustainability agenda since the mid-2000s, substituting earlier perspectives with systemic, biophysical, and moral critiques (Rockström et al., 2009; Steffen et al., 2015). This shift is defined by increasing recognition at the level of the lead international reports—with the HDRs—of planetary boundaries, resilience, and the Anthropocene at the heart of human development (UNDP, 2011, 2020).

Major ecological economics concepts, such as robust sustainability (Daly, 1996; Neumayer, 2010), planetary boundaries (Rockström et al., 2009), resilience and complexity (Holling, 1973; Perrings, 2006), and entropy (Georgescu-Roegen, 1971; Martinez-Alier, 2002), have increasingly influenced HDR definitions of sustainability and resilience. Although rarely directly cited, these concepts emerge through additional consideration of ecological integrity, non-substitutability of ecosystem services, and recognition of ecological thresholds (UNDP, 2020). Additionally, environmental economics remained institutionally compatible with economic institutions such as the World Bank, OECD, and national environmental agencies. This resulted in rapid integration into policy design through instruments such as tradable permits, pollution levies, and green national accounts (Baumol & Oates, 1988; Schmalensee et al., 1998). Its applied character tended to hide deeper structural shortcomings revealed by ecological economics.

Consequently, ecological economics, headed by economists like Georgescu-Roegen, Daly, Costanza, Martinez-Alier, Raworth, Jackson, Spash, and Fischer-Kowalski, conventionally experienced institutional antagonism due to direct challenge of growth and aggressive integration of ecological realism and ethical pluralism into economics (Costanza et al., 1997; Daly, 1996; Jackson, 2009; Raworth, 2017). Ecological economic visions, however, increasingly influenced global sustainability thinking indirectly, notably through planetary health and systemic ecological risk debates in HDRs (UNDP, 2020).

Thus, this chapter serves necessary background by clearly siting the analytical focus and intellectual expectation shaping the exhaustive empirical analysis. The chapter high-

lights how discovered paradigmatic trends arising out of qualitative perceptions meet international policy discourses, providing valuable understanding concerning interaction between ecological and economic paradigms shaping contemporary sustainability frameworks enshrined within HDRs.

4.1.1. Key Influential Concepts

Certain key ideas have significantly shaped sustainability discourses, particularly at the international policy level such as the United Nations Development Programme's (UNDP) *Human Development Reports (HDRs)*. Preliminary reviews shows, although there is still need of detailed empirical validation through bibliometric analysis, backed by dominant literature, reflect important conceptual trends and evolutionary developments. These ideationally influential ideas arise out of two main intellectual traditions: environmental economics, out of neoclassical economics and market-based fixes, and ecological economics, centered on biophysical limits, ethical pluralism, and systemic resilience. Environmental economics methods—inclusively externalities, environmental cost internalization, green national accounts, and market instruments such as pollution permits that are tradeable and environmental taxation—dominated world sustainability discourse initially due to their high institution compatibility and consistency with existing economics methods (Baumol & Oates, 1988; Pearce, 1993; Nordhaus, 1992; Solow, 1991). Pigou (1920) and Coase (1960)'s notion of externalities, since then, has been particularly central, emphasizing environmental damages' internalization into market decisions by levies, bribes, and trading schemes of gases (Coase, 1960; Pigou, 1920). Measures such as green GDP and environment-adjusted national accounts became the stars throughout the 1990s and 2000s, endorsed by institutions such as the World Bank, the OECD, and the IMF, with sustainability incorporated into mainstream economics policy instruments (Schmalensee et al., 1998; Pearce & Atkinson, 1993; UNDP, 1996, 1998).

Ecological economics advanced more profound, systems-level thinking, contending that genuine sustainability entails understanding intrinsic biophysical limits that extend beyond market valuation. Central concepts that are at the core of such a paradigm are

planetary boundaries that describe significant thresholds that human civilization cannot pass and must remain underneath or severely jeopardized catastrophically destroying the ecological realm (Rockström et al., 2009; Steffen et al., 2015). Even though the planetary boundaries formulation never directly featured in HDRs during their developmental years, the aligned principle that there are ecological thresholds took centerstage considerably from the years around 2011 onwards, notably HDR 2011 and HDR 2020, in contending that sustaining life-support systems of the planet should remain within safe bounds (UNDP, 2011, 2020).

Another such pillar is resilience and adaptive management such as developed by Holling (1973) and elaborated by Folke (2006) and Perrings (2006). These theories highlight the capacity of socio-ecological systems for absorbing disturbances and adapting accordingly, rather than focusing on stationary equilibrium states preferred by orthodox economic thinking (Folke, 2006; Holling, 1973; Perrings, 2006). Recent HDRs refer to resilience explicitly, highlighting it as significant for responding to systemic global risks such as climate change, economic crisis, and health epidemics (UNDP, 2014, 2020).

Strong sustainability, advanced by Daly (1996) and Neumayer (2010), emphasizes the non-substitutability of essential constituents of natural capital, rejecting common substitutability assumptions stemming from weak sustainability paradigms (Daly, 1996; Neumayer, 2010). Even if the explicit term of strong sustainability developed gradually, its philosophy increasingly influenced HDR approaches and discussions regarding ecological integrity and intergenerational equity, noticeably present in HDR 2011 and following reports (UNDP, 2011, 2020).

Moreover, ecological economics makes significant critical remarks from thermodynamics, most significantly Georgescu-Roegen's (1971) utilization of entropy within the realm of economic processes and Martínez-Alier's (2002) focus on ecological distribution struggles. These perspectives argue that economic activity by its nature is subject to entropy, therefore focusing on core physical limits to sustained growth and resource exploitation (Georgescu-Roegen, 1971; Martínez-Alier, 2002). Recent HDRs have an increasing ac-

knowledge of such thermodynamic limits by critical debates focusing on resource depletion, the erosion of biodiversity, and climate implications (UNDP, 2011, 2020).

Anthropocene, defined by Crutzen (2002) and elaborated by Steffen et al. (2007), emphasizes humankind's historically distinct and deep impact on the environment, necessitating a critical reappraisal of economic systems within environmental limits (Crutzen, 2002; Steffen et al., 2007). Anthropocene has greatly shaped most contemporary HDRs, particularly the 2020 HDR, positioning human development firmly within planetary bounds with a critical requirement for systemic changes within economics and the environment (UNDP, 2020).

Initially, ecological economics thought had little impact within dominant policy paradigms. Nevertheless, over the past few decades, such thought has increasingly influenced global institutional discourses, mirrored by various HDRs that embed such ideas as planetary boundaries, resilience thinking, strong sustainability, and the Anthropocene within their analytical and policy instruments (UNDP, 2011, 2014, 2020). Such rising institutional legitimacy is consistent with broader intellectual advocacy for systemic reform toward addressing some of the most prominent ecological and social sustainability challenges (Raworth, 2017; Jackson, 2009; Hickel, 2020). It is therefore important to scrutinize these influential ideas, their trajectories of intellectual thought, and how they have increasingly been embedded into international sustainability discourses. Beyond shedding light on previous trends of conceptual adoption, such analysis provides an important basis for understanding which ideas have been actually adopted, resisted, or altered within the broader context of global sustainability governance.

4.1.1.1 Externalities and Market Efficiency. The concept of externalities, first discussed by economist Arthur Pigou, is among environmental economics' foundations and has significantly shaped the thinking and policy instruments regarding environmental management (Pigou, 1920). Externalities are benefits or damages generated by economic activities that impact third parties and are not accounted for in market exchanges, and accordingly, generate market failures and inefficient allocations of resources (Baumol & Oates, 1988; Tietenberg & Lewis, 2018). Pigou's solution was corrective taxation—or

more simply, by the term Pigouvian taxes—to internalize such external damages, introducing environmental damages into market prices, enhancing economic efficiency, and reducing environmental deterioration (Pigou, 1920; Baumol & Oates, 1988).

Ronald Coase (1960) expanded this school of thought by advancing the Coase Theorem. In his case, clearly defined property rights and low transaction costs permit effective correction of externalities by private bargaining, often reducing or eliminating the need for direct governmental action (Coase, 1960). Coase's thought greatly influenced environmental policy instruments like tradable emissions permits, pollution trading programs, and market-based regulatory systems, thereby greatly informing the practical tools that environmental economists and international institutions employ (Schmalensee et al., 1998; Stavins, 1998; Tietenberg, 2006).

From the 1990s onward and up until the early 2000s, such theoretical inputs by Pigou and Coase emerged at the forefront of international sustainability policy narratives. Global institutions such as the World Bank, International Monetary Fund (IMF), and the Organisation for Economic Co-operation and Development (OECD) used such ideas extensively for policy advice and sustainable development guidelines (UNDP, 1992, 1996, 1998). Pioneering environmental economists such as William Nordhaus, David Pearce, and Robert Solow implemented these ideas through tools such as cost-benefit analysis (CBA), environmentally-adjusted national accounting (green GDP), and net savings adjustments. These tools actually embodied environmental damages in numbers, bringing sustainability considerations into regular economic measures and thus bringing environmental concerns into orthodox economic analysis and policy (Nordhaus, 1992; Pearce, 1993; Pearce & Atkinson, 1993; Solow, 1991).

HDR 1996 and HDR 1998 emphasized instruments oriented toward the market and environmental valuation as critical instruments for sustainable development with direct institutional influence from such environmental economics ideologies (UNDP, 1996, 1998). Cost-benefit analysis and green national accounting strategies were urged toward informing resource allocations and environmental policy with incremental changes through sus-

tained growth trajectories.

But even with widespread organizational receptiveness, the market-based solution focused on externalities has been severely criticized by ecological economics. Ecological economists argue that market-based instruments are deficient in dealing with deeper systemic ecological risks, distributive justice concerns, moral issues, and fundamental biophysical thresholds (Daly, 1996; Martínez-Alier, 2002; Spash, 1999, 2012; Vatn, 2005). Critics mention that such instruments of ecological economics have the tendency to oversimplify complex ecological realities, ignore irreversibilities of ecological processes, and do not attach proper significance to intrinsic and non-market values (Daly, 1996; Spash, 2012; Vatn, 2005). HDR 2011 and HDR 2020, e.g., progressively embodied such criticism by including discussions pertaining to ecological thresholds, resilience, and systemic issues of sustainability, which demonstrates an incremental but apparent shift towards recognizing that there are thresholds embedded within market-based instruments for environmental policy (UNDP, 2011, 2020).

More recently, this criticism has given rise to an expanded sustainability discussion, such as planetary boundaries, resilience, and robust sustainability, put forward by Rockström et al. (2009), Steffen et al. (2015), and Raworth (2017). These scholars advocate for an expanded integration of ecological circumstances and systemic sustainability problems into global sustainability governance that extends considerably beyond internalizing externalities toward profound systemic changes (Folke, 2006; Neumayer, 2010; Raworth, 2017).

Thus, even if externalities remain the central conceptual and methodological tool in environmental economics, present discussions underscore the importance of increasing the integration of ecological constraints, distributive justice, moral diversities, and thinking in terms of resilience into policy tools. This shift is an incremental evolution of the sustainability argument towards increased ecological realism and systemic thinking (Daly, 1996; Raworth, 2017; UNDP, 2020).

4.1.1.2 Natural Capital and Weak Sustainability. Evolved from the known economics concept of externalities, the term natural capital emerged prominently for the first time in environmental economics with far-reaching consequences for contemporary sustainability discussion. Born and propagated by authors such as David Pearce, Robert Costanza, and Herman Daly, natural capital refers generically to the stock of nature's assets and ecological goods such as water, soil, forests, biodiversity, and atmosphere that provide essential ecosystem services for human well-being and economics (Costanza et al., 1997; Pearce, 1993; Daly, 1996). Such conceptualization of the natural capital resulted in the sustainability framework known as *weak sustainability*, arguing that sustaining sustainability is assured by ensuring that there is a stable or non-decreasing aggregate total stock of capital consisting of natural, human, social, and manufactured capital (Solow, 1991; Pearce & Atkinson, 1993). Under assumptions of substitutability between different types of capital with conditions of weak sustainability, it is conceivable that destruction of the natural capital could be offset by increases in human or manufactured capital (Neumayer, 2010). Weak sustainability thinking has profoundly influenced orthodox environmental policy, economic valuation, and global sustainability measures like adjusted net savings (ANS), environmentally-adjusted GDP ("green GDP"), and inclusive measures of wealth accounting (Pearce, Hamilton, & Atkinson, 1996; World Bank, 2011; Dasgupta, 2021).

These concepts have been adopted by global institutions such as the World Bank, OECD, and national statistical offices, predominantly due to their compatibility with neoclassical economics methodology and prevailing institutions (Hamilton & Clemens, 1999; World Bank, 2011). High-profile indicators, such as the Inclusive Wealth Index (IWI) and net savings measures corrected for numerous factors, have been employed for national sustainability progress appraisal and comparison purposes, bringing the approach to natural capital within international environmental and developmental governance literature (UNU-IHDP & UNEP, 2012; Dasgupta, 2021). Human Development Reports (HDRs) throughout the 1990s and first decades of the 2000s increasingly reflected this conceptual focus by including green national accounting debates and emphasizing environmental assets' role within broader human developmental agendas (UNDP, 1996; UNDP, 1998; UNDP, 2000; UNDP, 2003).

However, this framework has come into widespread criticism by ecological economists, given that they consider that weak sustainability insufficiently identifies significant ecological thresholds, irreversible harm, and non-interchangeable ecosystem services, and tends to overlook long-term ecological integrity and intergenerational equity risks (Daly, 1996; Neumayer, 2010; Martínez-Alier, 2002; Costanza et al., 2014). Despite such criticisms, natural capital and weak sustainability frameworks are prevalent throughout policy circles due to their pragmatic flexibility, practicality, and compatibility with market-based environmental management strategies (Solow, 1991; World Bank, 2011; Hamilton & Clemens, 1999).

Existing literature emphasizes the need for differentiating between approaches to weak and strong sustainability with great care, with explicit reference to substitution thresholds, some ecological changes that are irreversible, and ethically forward-looking considerations with respect to future generations (Brand, 2009; Neumayer, 2010; Dasgupta, 2021). Recent HDRs, including the 2011 report with a thematic focus on sustainability and equity and the 2020 report with explicit reference to planetary pressures, accordingly increasingly reflect awareness of such critiques, emphasizing the need for measures of sustainability that are more integrative and comprehensive and that take explicit reference to ecological thresholds and resilience (UNDP, 2011; UNDP, 2020). Natural capital accordingly remains the most common conceptual tool within measures and policy for sustainability, yet ongoing debates reflect the importance of integrating robust thinking with respect to ecology, normative pluralism, and ethically focused perspectives within policy instruments and governance with respect to sustainability economics and governance (Costanza et al., 2014; Raworth, 2017; Rockström et al., 2009).

4.1.1.3 Strong Sustainability and Biophysical Limits. Markedly different from weak sustainability, the concept of strong sustainability—with principal foundations within ecological economics—emphasizes the critical importance of some irreplaceable elements of natural capital, such as biodiversity, climatic stability, resilience of ecosystems, and ecological integrity (Daly, 1991; Neumayer, 2010). Underlying this notion of strong sustainability is the argument that numerous ecosystem services and resources are distinct and cannot be substituted with humanmade capital with serious and even potentially

devastating consequences for human well-being and integrity of ecosystems (Costanza et al., 2014; Daly, 1996; Ekins et al., 2003). Strong sustainability's theoretical basis has greatly benefited from Herman Daly's (1991, 1996) *steady-state economy* proposition, which especially incorporates biophysical growth limits for the economy and promotes maintaining the same scale of economic activity at the planetary ecological carrying capacity. Nicholas Georgescu-Roegen's (1971) contribution of entropy and the thermodynamic laws to reflections on the economy took this even further by emphasizing inherent biophysical limits on sustained economic growth and substitutability of resources (Farley & Daly, 2010; Georgescu-Roegen, 1971).

It shifts analytical focus out of purely economic valuation and market processes toward respect and recognition for absolute biophysical limits, irreversible ecological thresholds, and planetary boundaries that define humankind's safe operating space (Rockström et al., 2009; Steffen et al., 2015; Folke et al., 2021). Recent research increasingly demonstrates how the breaching of such planetary boundaries—such as those related to climate change, biodiversity loss, ocean acidification, and freshwater depletion—can cause radical ecological disturbances, prompting policy and governance institutions to increasingly move toward strong sustainability perspectives (Folke et al., 2021; Steffen et al., 2018).

It has increasingly found space in international sustainability discussions, notably with the most recent United Nations Development Programme (UNDP) Human Development Reports (HDRs). HDRs published in 2011 and 2020 mention planetary boundaries, resilience, and ecological integrity directly, which reflect partial but significant institutional recognition of strong sustainability thinking (UNDP, 2011; UNDP, 2020).

While organizational adoption of strong sustainability is difficult due to its critical approach toward growth-oriented theories of economics, market-based valuation approaches, and ingrained socio-political power structures (Martínez-Alier, 2002; Spash, 2012; Raworth, 2017), proponents of strong sustainability push for transformative structural changes of economic systems, emphasizing sufficiency, environmental care, distributive justice, and systemic strength over incremental improvements toward efficiency

or adjustments (Jackson, 2009; Raworth, 2017; Hickel, 2020; Kallis, 2018).

Continued integration of robust sustainability principles into global governance frameworks depends on effective methods for valuing significant natural capital, resilience, and environmental thresholds, along with political will toward implementing transformative changes that achieve genuine sustainability (Costanza et al., 2014; Raworth, 2017; Hickel, 2020; Brand, 2009).

4.1.1.4 Resilience, Complexity, and Adaptive Systems. Another key conceptual contribution by ecological economics is that of the systems-based idea of resilience. First articulated by Holling (1973), resilience is conceptualized here as the capacity for absorbing disturbances, adapting, and recovering by rebuilding itself without deep structural or functional changes (Holling, 1973; Gunderson & Holling, 2002). In this respect, the prevailing equilibrium-based economic approaches are opposed sharply by the importance given here by this idea to the complexity, interconnectedness, and non-linear dynamics that are inherent to social-ecological systems (Folke, 2006; Berkes, Colding, & Folke, 2003). Resilience thinking makes the uncertainties and adaptive capacities that are inherent to complex systems explicit, arguing that governance structures and policy architectures need to have adaptive and flexible responses to increasing ecological and socioeconomic disturbances (Walker et al., 2004; Folke et al., 2005). Aware that socio-ecological systems are not near equilibrium, resilience theory stresses adaptability, transformability, and learning as important properties that are necessary for managing systemic risks effectively and for enabling sustainable transitions (Folke et al., 2010; Levin et al., 2013).

Complexity-based thinking ingrained in resilience thinking has gathered significant momentum in world sustainability thinking, notably with increasing recognition that cross-linked crises such as climate change, biodiversity losses, economic shocks, and planetary pandemics reveal the brittleness of tightly coupled global systems (Folke et al., 2021; Perrings, 2006; Rockström et al., 2009; Steffen et al., 2015). Recent United Nations Development Programme Human Development Reports (HDRs) have increasingly included resilience and systemic risk management, reflecting broader organizational trends toward

recognizing the critical need for adaptive capacities and transformative changes toward sustainable human development (UNDP, 2011; UNDP, 2014; UNDP, 2020).

Moreover, resilience thinking accords with adaptive governance arrangements by emphasizing decentralized decision-making, polycentric governance institutions, multi-stakeholder engagement, and iterating learning processes as the principal instruments for developing and maintaining system resilience (Ostrom, 2009; Folke et al., 2005; Biggs et al., 2015). In comparison with traditional centralized governance arrangements, adaptive governance promotes more adaptive, inclusive, and iterative policy instruments with the ability to address effectively embedded uncertainty and complexity found within contemporary sustainability challenges (Adger, 2006; Biggs et al., 2015).

Thus, resilience theory and complexity science offer landmark theoretical and practical instruments for engaging with sustainability within rapidly fluctuating, unpredictable, and intensely connected Anthropocene planetary systems. Through systemic thinking, adaptive governance structures, and resilient policy, development practice and policy voices have the potential to identify and adjust more acutely to Anthropocene-era sustainability challenges, facilitating greater long-term social-ecological well-being (Folke et al., 2021; Levin et al., 2013; Walker et al., 2004).

4.1.1.5 Degrowth, Post-Growth, and Alternative Economic Visions. Radical alternatives and critiques in the form of degrowth and post-growth economics challenge the assumptions that animate orthodox, growth-based economic systems. Arising from ecological economics, the degrowth movement questions the environmental sustainability and social justice impacts of unlimited economic growth, uncovering hidden dilemmas between unlimited growth, environmental sustainability, and equitable human progress (Latouche, 2009; Jackson, 2009; Raworth, 2017; Martínez-Alier, Pascual, Vivien, & Zaccai, 2010; Kallis, 2018; Hickel, 2020). Tim Jackson's seminal work, *Prosperity without Growth*, argues convincingly for recasting prosperity away from GDP growth and focusing instead on social well-being, environmental resilience, fair sharing of resources, and enhancing quality of life irrespective of continuing material growth (Jackson, 2009). Kate Raworth's "Doughnut Economics" similarly pronounces an integrative blueprint delineating

a "safe and just operating space" for humankind bounded by ecological ceilings (planetary boundaries) and social bases (minimum social standards), candidly critiquing prevailing growth-based economics orthodoxies and suggesting balanced, distributive justice-based economies (Raworth, 2017; Raworth, 2012).

Serge Latouche's theoretical perspective of "convivial degrowth" promotes voluntary simplicity, reduced production and consumption, and values the culture and societal dimensions of moving out of consumerist logic-based economies toward sustainability and sufficiency (Latouche, 2009). In alignment with these thought lines, Joan Martínez-Alier's "environmentalism of the poor" identifies socio-ecological conflicts owing to economic growth, with a principal focus on ecological debts and environmental justice struggles most evident in Global South experiences (Martínez-Alier, 2002; Martínez-Alier et al., 2010; Martinez-Alier, Temper, Del Bene, & Scheidel, 2016).

While post-growth and degrowth thinking has always remained quite peripheral within the mainstream policy institutions such as the United Nations Development Programme (UNDP), their intellectual influence is now evident in most recent Human Development Reports (HDRs). In particular, most recent HDRs have now critically debated systemic injustices, unsustainable consumption and production patterns, and environmental crises, implicitly engaging with the literature and thinking on degrowth. Even the HDR of 2020 directly refers to the necessity of rediscovering human development in the Anthropocene age, implicitly conceding the challenges posed by post-growth and degrowth researchers regarding planetary thresholds, injustice, and unstable patterns of economic growth (UNDP, 2020; Hickel, 2020; O'Neill, Fanning, Lamb, & Steinberger, 2018).

Expanding policy and academic literature increasingly recognizes post-growth and degrowth economics' transformative capacity for imagining equitable, ecologically compatible, and socially equitable developmental pathways. For example, agendas concerning sufficiency-based consumption, basic income initiatives, and ecological redistribution assume policy prominence with this emphasis that systemic economic transformation consistent with ecological integrity and social justice is necessary (Kallis, 2018; Hickel, 2020;

Büchs & Koch, 2019).

Thus, post-growth and degrowth perspectives offer valuable intellectual foundations and policy tools for devising transformative agendas for sustainability, promoting overall societal welfare, ecological resilience, and equitable human development within planetary bounds.

4.1.1.6 Anthropocene and Planetary Boundaries. Anthropocene and planetary boundaries are connected conceptualizations that are part of the significant contemporaneous shift in sustainability discourses, highlighting the scale and systemic nature of human modification of the environment. Anthropocene, named by chemist Paul Crutzen, is a new geological epoch marked by extensive modification at the earth's systems by humankind, with notable examples including modification of the climate, extinction of biodiversity, and radical alterations of the biochemical cycles (Crutzen, 2002; Steffen et al., 2007). The shift in conceptual thought points out the enormous, potentially irreversible environmental effect of humankind and stresses the need for reviewing global developmental patterns and governance methodologies with a view to tackling these new challenges that have no precedence (Steffen et al., 2018; Lewis & Maslin, 2015). Complementing the Anthropocene framework, the planetary boundaries framework, developed by Johan Rockström, Will Steffen, and their coauthors, represents a scientifically rigorous formulation of critical ecological thresholds that must be respected by human societies if we are to forestall abrupt disruptions of the life-support systems of Earth (Rockström et al., 2009; Steffen et al., 2015). The planetary boundaries framework documents nine critical processes—climate change, biodiversity loss, biogeochemical cycles, ocean acidification, land-use change, freshwater use, ozone depletion, aerosol loading in the atmosphere, and chemical pollution—in which human activities should stay if we are to achieve stable and secure operating spaces for human societies (Steffen et al., 2015; Rockström et al., 2009).

Integration of such thought within planetary sustainability discussions has risen considerably over the past decades, most significantly within the United Nations Development Programme's (UNDP) Human Development Reports (HDRs). The HDR for 2020 makes explicit mention of Anthropocene and planetary boundaries, recognizing that hu-

man development sustainability relates to an ontological transformation within economic frameworks and governance structures toward managing systemic ecological dangers, biophysical boundaries, and thinking regarding resilience (UNDP, 2020; UNDP, 2015–2023; UNDP, 2011). Such acknowledgment represents a significant institutional step toward embracing central ecological economics thought that emphasizes biophysical constraints, complexity, and the non-substitutability of critical ecosystem services (UNDP, 2020; UNDP, 2011; Folke et al., 2021).

Despite increasing visibility, there are persistent obstacles for these concepts to be fully implemented in mainstream development policy. Institutional structures continue often to favor incremental repairs, technological optimism, and growth-based orientations, with partial incorporation and remaining antagonism toward ecological criticisms of economics and dominant development agendas (UNDP, 2020; Hickel, 2020; Raworth, 2017). By contrast, reference in recent HDRs to Anthropocene and planetary boundaries demonstrates an emerging institutional discourse increasingly aligned with global human development perspectives and ecological realism, systemic thinking, and resilience-based governance (UNDP, 2020; Rockström et al., 2009; Steffen et al., 2015).

Thus, collectively, Anthropocene and planetary boundaries frameworks offer common conceptual and practical tools for assisting global transformation agendas towards sustainability, demanding integrative and comprehensive approaches for solving ecological and socio-economic complexities within safe planetary boundaries (Folke et al., 2021; Steffen et al., 2018; UNDP, 2020).

4.1.1.7 Conclusion of Key Concepts. Concurrently, these seminal thought-workings provide a structured intellectual map plotting the shift in paradigmatic influence informing global sustainability discourses and policy at the level of the United Nations Development Programme's (UNDP) *Human Development Reports* (HDRs). HDRs first began with environmental economics approaches focusing on market-based mechanisms, externalities valuation, green accounting, and weak sustainability, reflecting institutional coherence with prevailing approaches and methods of economic growth (UNDP, 1996; UNDP, 1998; Pearce & Atkinson, 1993; Solow, 1991). Early policy discourses accord-

ingly gave priority to incremental economics adjustments, technological optimism, and market-based approaches to environmental impact management (Nordhaus, 1992; Pearce, 1993; Schmalensee et al., 1998; UNDP, 2000). However, with time and especially since 2000, HDR narratives have increasingly but substantially included critical perspectives from ecological economics. These have included rising recognition of biophysical limits, resilience thinking, robust sustainability, and systemic risk with reference to planetary thresholds and the Anthropocene (Rockström et al., 2009; Steffen et al., 2015; Folke et al., 2021; UNDP, 2011; UNDP, 2020). These latter frameworks have greater emphasis on seeing ecological limits, non substitutability of critical stocks of natural capital, and capturing the complexities inscribed within socio-ecological systems—issues that have hitherto been thin within purely market-based sustainability paradigms (Daly, 1996; Georgescu-Roegen, 1971; Raworth, 2017).

This rising integration of ecological economics thinking is powerfully evidenced by influential HDRs such as the 2011 *Sustainability and Equity* report and that HDR by the year 2020 focused entirely on human development in the Anthropocene (UNDP, 2011; UNDP, 2020). These HDRs acknowledge ecological limits, but additionally they advocate transformative governance structures that are resilient to systemic ecological risks, resilience, and adaptive capacities supporting genuinely long-term sustainability (UNDP, 2020; Folke et al., 2021; Rockström et al., 2009; Steffen et al., 2018).

Nonetheless, organizational uptake of such environmental thought remains partial and controversial, reflecting sustained strains between dominant growth orthodoxies and more radical ecological critiques that demand seismic shifts in planetary developmental paradigms (Hickel, 2020; Raworth, 2017; Kallis, 2018).

Overall, this first conceptual examination highlights how rising adoption and integration of ecological economics visions into global policy reports, such as HDRs, signify broader shifts towards ecological realism, resilience thinking, and sustainability strategies that directly acknowledge and embed biophysical limits, complexity, and pluralistic ethics at the international human development policy level (UNDP, 2020; Folke et al., 2021;

Rockström et al., 2009; Steffen et al., 2015).

4.1.2. Influential Scholars in Environmental Economics

Environmental economics became increasingly prominent in the middle decades of the 20th century when scholars first employed neoclassical theories and tools of economics to address environmental devastation and resource use questions. Some key scholars, headed by Arthur Pigou, Ronald Coase, William Nordhaus, Robert Solow, and David Pearce, greatly influenced theoretical developments and application-based policy instruments with such pioneering concepts as externalities, market optimality, corrective taxes, and environmental cost internalization (Baumol & Oates, 1988; Tietenberg & Lewis, 2018). Arthur Pigou (1920) performed seminal contributions by interpreting the concept of *externalities* as uncompensated side effects of economic activities that impact third parties. Pigou proposed corrective taxation—later dubbed *Pigouvian taxes*—as tools for internalizing such external harm, rendering the private calculation compatible with broader social welfare (Pigou, 1920; Baumol & Oates, 1988). Pigou’s line of thought became part and parcel of environmental economics, constituting the basis for future policy tools such as carbon taxes, pollution levies, and environmental charges (Pearce, 1993; Tietenberg & Lewis, 2018).

Ronald Coase (1960) subsequently criticized and reframed Pigou’s thought process by advancing the *Coase theorem*. Coase asserted that environmental externalities could be efficiently resolved by market forces regardless of direct governmental regulation with well-specified property rights, low transaction costs, and voluntary bargaining (Coase, 1960). This argument led policy discussions toward market-based corrections, such as tradable permit schemes for pollution and pollution trading programs, with significant influences on institutions such as the World Bank, OECD, and numerous environmental protection agencies throughout the world (Schmalensee et al., 1998; Stavins, 1998).

William Nordhaus significantly contributed to environmental economics by developing integrated assessment models (IAMs) that bridged climate science with economics-based

growth. His most famous Dynamic Integrated model of Climate and the Economy (DICE) provided a basis for rigorously evaluating optimal greenhouse-gas mitigation strategies and significantly impacted global discussions regarding climate policy and institutional calculations regarding climate (Nordhaus, 1992, 2018). Nordhaus's research directly influenced cost-benefit analysis, carbon-price methods, and international negotiation regarding climate through institutions such as the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC).

Robert Solow (1991), the famous neoclassical growth economist, gave more by theoretical formulation of sustainability by reference to an economic growth model with the proposition of *weak sustainability*. This revolves around substitutability between nature and manmade capital and introduces sustainability as a function of maintaining an aggregate stock of capital over time (Solow, 1991; Neumayer, 2010). Solow's line of argument has formed policy indicators such as adjusted net savings (ANS) and environmentally-adjusted GDP (green GDP), commonly employed by such institutions as the World Bank and the OECD for measurements of progress toward sustainability (World Bank, 2011).

David Pearce subsequently went on to elaborate and solidify environmental economics by developing practical policy instruments such as green GDP and natural capital accounting. Bounding and Turner's pioneering work with respect to sustainability indicators and valuation approaches have significantly impacted practical usage of environmental economics at the global scale and at the scale of global developmental policy (Pearce, 1993; Hamilton & Clemens, 1999; Pearce & Atkinson, 1993).

These scholars collectively put environmental economics at the forefront as the dominant institutional perspective for addressing environmental issues with the assistance of orthodox economic tools. Their theories and methods prevailed most significantly in international sustainability narratives, especially the earlier United Nations Development Programme (UNDP) Human Development Reports (HDRs) during the 1990s and early 2000s, that employed market-based instruments, economic valuation, and green account-

ing as core methods for achieving sustainable development (UNDP, 1992, 1996, 1998, 2000, 2003).

Nonetheless, despite widespread adoption by institutions, environmental economics methods have seen widespread criticism by ecological economists for failing adequately to address systemic ecological thresholds, distributive justice, moral issues, and the inherent complexity of socio-ecological systems (Daly, 1996; Martínez-Alier, 2002; Spash, 2012). These criticisms indicate remaining tension and inadequacies of exclusively market-based methods, predicting an emerging paradigm shift toward the adoption of ecological economics' deeper structural observations and normative concerns into current-day sustainability governance institutions.

4.1.2.1 Arthur Cecil Pigou (1877–1959). Arthur Cecil Pigou is commonly known as the intellectual father of environmental economics, essentially due to his path-breaking work on externalities and market failures. Pigou, in his classic work, *The Economics of Welfare* (1920), first formulated the notion of externalities by explaining that these are costs and benefits arising due to economic activities that incidentally have an impact on third parties but are neither reflected nor incorporated by market prices (Pigou, 1920; Baumol & Oates, 1988). Pigou found such externalities as the basic market failures where the outcome of private markets deviates from socially or optimally preferred outcomes, resulting in inefficient resource usage and environmental damages (Pearce, 2002; Sandmo, 2015). Pigou proposed a corrective device for the market, which we now refer to as *Pigouvian taxation*, that taxes or subsidizes such that external benefits or costs are internalized into market transactions (Pigou, 1920; Sandmo, 2015). This taxing corrective principle lies behind current environmental policy instruments like carbon levies, pollution charges, environmental levies, among other incentive-based instruments of regulation that are now in practice all over the globe (Pearce, 2002; Tietenberg & Lewis, 2018; Stavins, 2003).

Pigou's thought profoundly shaped policy instruments employed by influential world organizations such as the World Bank, OECD, and the United Nations, informing early environmental governance frameworks that have played a prominent role in Human Development Reports (HDRs) throughout the 1990s and early 2000s (UNDP, 1992, 1998,

2000). These reports significantly drew upon Pigou's conceptualization of externalities when suggesting market-based approaches to sustainably developing the environment with plans for balancing environmental conservation and economic growth (Hamilton & Clemens, 1999; World Bank, 2011).

Despite powerful institutional support for Pigouvian thought, his framework has been subjected to critical critique by ecological economists, who argue that it fails adequately to engage with deeper structural issues such as ecological limits, intergenerational equity, and distributive justice (Daly, 1996; Spash, 2012). Regardless, Pigou's intellectual heritage is at the heart of environmental economics, providing basic economic justification and tools for addressing environmental challenges.

4.1.2.2 Ronald H. Coase (1910–2013). Ronald H. Coase widely influenced environmental economics and policy literature with his now-classic work, *The Problem of Social Cost* (1960). Coase attacked the orthodox Pigouvian solution, emphasizing taxation and government intervention as methods of controlling externalities, by proposing an entirely different mechanism that could address the issues. His idea came to be known as the Coase Theorem, and it claimed that externalities could be addressed efficiently by direct bargaining between affected parties, if property rights are established with precision, and transaction costs are low (Coase, 1960; Medema, 2020). Coase's theorem actually steered the argument away from solely corrective levies by the government towards market-based measures, emphasizing that with proper institutional arrangements, private exchanges could yield socially optimal outcomes even without direct regulation (Stavins, 2003; Tietenberg & Lewis, 2018). This finding significantly expanded policy arguments and formed the basis for theoretical support for market-based environmental instruments like permit trading, emission trading regimes, and environmental credits, becoming pillars of contemporary environmental regimes around the globe (Schmalensee et al., 1998; Stavins, 2003).

Coase's work in particular addressed international environmental policy directly, informing organizations such as the Organisation for Economic Co-operation and Development (OECD), the World Bank, and United Nations agencies. Early *Human Development Re-*

ports (HDRs) from the 1990s and the first part of the 2000s frequently referenced market-based instruments, tradable permits, and property-rights approaches modeled after Coase's theorem, which they saw as possible instruments for environmental sustainability and for economic growth (UNDP, 1992, 1998, 2000; Pearce, 2002).

However, regardless of how powerful its influence has been, the Coasean approach has, nevertheless, remained subject to critical analysis by ecological economists, particularly with respect to assumptions regarding low transaction costs, clear property rights, and equal bargaining power among agents. Ecological economists have argued that such environments barely exist in complex environmental challenges, especially those that relate to global commons, ecological thresholds, distributive justice, and irreversible environmental destruction (Martínez-Alier, 2002; Spash, 2012; Vatn, 2005).

But Coase's theoretical contribution remains seminal for environmental economics and has deeply shaped global environmental policy structures, institution frameworks, and prevailing debates concerning efficient and equitable environmental governance (Tietenberg & Lewis, 2018; Medema, 2020).

4.1.2.3 William D. Nordhaus (1941–present). William D. Nordhaus is world-famous for being among the most influential environmental economists of our time, chiefly because his work pioneered climate economics by developing and applying Integrated Assessment Models (IAMs). Nordhaus' most famous model, the Dynamic Integrated Climate-Economy (DICE) model, integrates climate science with economic models for the purpose of evaluating the given trade-offs between the cost of avoiding climate change mitigation and avoided damages resulting from changes in the climate (Nordhaus, 1992, 2018). The DICE model includes cost-benefit analysis and intertemporal discounting explicitly, providing policy makers with quantitative tools with which various scenarios of climate policy have their economics evaluated (Nordhaus, 2018; Nordhaus & Boyer, 2000). Nordhaus's strategy, centered on economically optimal paths for reducing emissions by balancing present mitigation expenditure with future damages from global warming, significantly influenced global climate policy debates. His work counsels institutions utilized in international negotiation arenas, influencing influential organizations

such as the World Bank, the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), and the United Nations Development Programme (UNDP). Nordhaus's approaches toward economic valuation and endorsement of modest instruments of carbon pricing have constituted the basis of early global climate policy, having notably influenced the UNDP's Human Development Reports (HDRs) throughout the 1990s and 2000s (UNDP, 1998, 2007, 2011).

Despite universal institutional openness, Nordhaus's model has attracted significant criticism by ecological economists, climatologists, and ethicists. Critics argue that IAM-based studies, like DICE, tend to underestimate catastrophic risks due to global warming, seriously don't take deep uncertainty and irreversible ecological tipping points into consideration, and undervalue moral aspects of intergenerational and global distributive justice (Ackerman, Stanton, & Bueno, 2010; Stern, 2007; Weitzman, 2009). These criticisms mirror entrenched failures of exclusive dependence upon cost-benefit appraisal and intertemporal discounting and instead promote alternative bases for appraisal that are rooted upon precaution, resilience, and robust sustainability criteria (Spash, 2007; Pindyck, 2013; Raworth, 2017).

Despite that, Nordhaus' pioneering contribution remains intact in environmental economics and helps shape world climate change policy and economic policymaking trends. His influential contribution was officially recognized by the 2018 Nobel Memorial Prize in Economic Sciences, demonstrating his enduring impact on contemporary environmental economic thought and policy formulation (Nobel Prize, 2018).

4.1.2.4 Robert Solow (1924–present). Robert Solow has significantly influenced environmental economics with his theoretical argument for “weak sustainability,” itself founded upon his own groundbreaking work in economic growth theory and substitutability between types of capital. Solow's own groundbreaking neoclassical model of growth, originally proposed in his seminal 1956 article, established a theoretical construct that emphasized substitutability between types of humanmade capital, natural, and technological—in creating long-run economic growth (Solow, 1956). Originally developed without explicit environmental dimensions, Solow's growth theory provided the analytical basis

upon which environmental economists subsequently modeled economic growth with natural resource depletion (Hartwick, 1977; Hamilton & Clemens, 1999). Solow addressed sustainability directly within the sphere of economic theory with his influential speech, “Sustainability: An Economist’s Perspective” (Solow, 1991). In it, he established the axiom of weak sustainability that asserts that the destruction of natural capital is acceptable only as long as the welfare or consumption opportunity of future generations is not worsened. Central to such vision is the assumption that there exists an enormously high amount of substitutability between nature and humanmade capital that would imply that environmental resource destruction could be compensated by technological advancement and formation of capital (Solow, 1993; Neumayer, 2010).

Solow’s weak sustainability model has immensely influenced sustainability indicators, measures, and environmental accounting systems adopted by global institutions, including the World Bank, International Monetary Fund (IMF), and Organisation for Economic Co-operation and Development (OECD). His postulates have provided theoretic justification for widely used methods such as adjusted net savings (ANS), measures of inclusive wealth, and environment-adjusted national accounts that attempt at incorporating national accounting frameworks with ecological resource depletion (Hamilton & Clemens, 1999; Dasgupta, 2021; World Bank, 2011).

The influence of Solow’s weak sustainability idea has directly been evident across various United Nations Development Programme (UNDP) Human Development Reports (HDRs), most notably throughout the 1990s and early 2000s. Early HDRs embedded capital substitutability, resource depletion usage, and human well-being conceptualizations into their conceptualizations of sustainable human development, often referring to procedures aligned with Solow’s framework (UNDP, 1996, 1998, 2000). Solow’s perspective provided institutional agents with pragmatic analysis tools aligned with prevailing economic policy paradigms, resulting in widespread familiarity within international sustainability discourses.

But even the weak sustainability approach itself has been widely criticized by ecologi-

cal economists, who point out the limits of substitutability, above all for key ecosystem functions and essential natural capital (Daly, 1996; Ekins, Simon, Deutsch, Folke, & De Groot, 2003; Costanza et al., 2014). Critics argue that weak sustainability understates irreversibility, neglects important ecological thresholds, and fails adequately to address ethical issues related to intergenerational justice and long-term ecological integrity (Neumayer, 2010; Daly, 1996; Martínez-Alier, 2002).

Despite such criticisms, Solow's groundbreaking writings remain central to environmental economics, deeply shaping contemporary policy debates on sustainability, environmental valuation, and how ecological considerations are brought into economics decision-making.

4.1.2.5 David Pearce (1941–2005). David Pearce initiated and contributed toward “natural capital” and environmental valuation methods that have greatly influenced the integration of environmental factors into conventional economic analysis and policy making. His groundbreaking work developed fundamental pillars of environmental economics by rigorous valuation of environmental goods and ecosystem services, and suggested the integration of ecological values into cost-benefit analysis methods and national accounting systems (Pearce, 1993; Pearce & Atkinson, 1993).

Pearce's influential work, *Blueprint for a Green Economy* (Pearce, Markandya, & Barbier, 1989), provided one of the earliest thorough visions for translating environmental issues into practical policy prescriptions for the economy. This seminal report provided explicit policy advice for policy instruments such as pollution levies, tradeable permits, and environmental taxation, emphasizing the importance of internalising environmental externalities into market prices and national accounts. His work significantly influenced institutions at the global scale, notably the World Bank, OECD, and the United Nations Development Programme (UNDP), by facilitating early efforts at sustainability and green accounting frameworks, such as adjusted net savings (ANS) and environmentally-adjusted national accounting—in commonly known guise as “green GDP” (Pearce, Hamilton, & Atkinson, 1996; Hamilton & Clemens, 1999; World Bank, 2011).

From the 1990s until the first few years of the new millennium, HDRs often incorporated Pearce's conceptual inputs, especially highlighting environmental valuation methods and proposing the measurement and reporting of natural capital destruction as part of sustainable human development (UNDP, 1992, 1996, 1998, 2000). According to Pearce, incorporating environmental values into the scope of economic indicators could offer pragmatic instruments for policymakers that could balance out ecological sustainability with current priorities for sustained economic growth, thereby generating more enlightened and comprehensive policy choices (Pearce & Barbier, 2000).

However, methods and valuation of Pearce have themselves attracted critique. Ecological economists have tended to highlight the deficiencies of monetizing biodiversity and ecosystem services, that valuation frameworks have inadequate consideration for intrinsic ecological values, ethical issues, systemic ecological thresholds, and reversibility (Daly, 1996; Martínez-Alier, 2002; Spash, 2012). Despite such critiques, the legacy of Pearce is profoundly influential, having established a pragmatic approach that enabled significant integration of ecological consideration with mainstream policy structure and economic thought. It continues to provide the foundation for present environmental policy strategies that advocate economically savvy environmental protection and significantly shape global sustainability policy, indicators, and organizational behavior (World Bank, 2011; UNU-IHDP & UNEP, 2012; Dasgupta, 2021).

4.1.2.6 Robert N. Stavins (1948–present). Robert N. Stavins is one of the most influential environmental economist whose extensive research includes market-based policy instruments, notably tradable permits, cap-and-trade regimes, and economic instruments that combat environmental devastation, most notably in policy environments concerning climate change (Stavins, 1998, 2003). Stavins' seminal body of literature emphasizes market-based instruments because they are most efficient and effective by providing flexibility, economic incentives, and cost savings that meet environmental policy objectives at lower expense than the traditional approaches to regulation (Stavins, 2001; Aldy & Stavins, 2012). His landmark work on emissions trading regimes, most prominently elucidated by "What Can We Learn from the Grand Policy Experiment? Lessons from SO₂ Allowance Trading" (Stavins, 1998), incorporated rigorous empirical analysis and policy

recommendations learned from the successful U.S. trade program for sulfur dioxide that was effected with the 1990 Clean Air Act Amendments. This landmark work demonstrated how market instruments could significantly reduce compliance costs and attain superior environmental results at minimum cost, inscribing tradable permits within the realm of serious, politically plausible instruments capable of addressing global environmental challenges, including the challenge posed by climate change (Schmalensee et al., 1998; Stavins, 2003).

Stavins' research had significant consequences for global climate policy structures, particularly for framing the economic argument behind influential global environmental agreements such as the Kyoto Protocol and the Paris Agreement. Throughout many consulting roles and policy briefs, Stavins has vigorously promoted the adoption of cap-and-trade systems and carbon pricing tools as cornerstone components of effective global climate leadership, due to their potential to harmonize environmental protection with competitiveness and economic prosperity (Aldy & Stavins, 2012; Stavins, 2020).

These ideas have increasingly found their way into global institutional discussion, prominently included in new United Nations Development Programme (UNDP) Human Development Reports (HDRs), particularly discussions on climate policy, efficient deployment of resources, and market-oriented sustainability measures (UNDP, 2007, 2011, 2020). Stavins' advocacy for fiscally efficient policy instruments represents a pragmatic argument that reconciles environmental objectives with prevailing economics, enabling incremental yet important policy shifts within traditional institutional settings.

Despite universal institution backing, Stavins' market-based answer has come under fire by ecological economists that claim that emissions trading and market incentives fall short of addressing systemic environmental dangers, issues of fairness, and moral aspects connected with climate change (Spash, 2010; Martinez-Alier, 2002; Vatn, 2005). His landmark publication, nevertheless, continues influential throughout present environmental policy debates, advocating for economically savvy, market-congruent strategies toward global sustainability goals (Stavins, 2020; Aldy & Stavins, 2012).

4.1.2.7 Richard Schmalensee (1944–present). Richard Schmalensee has greatly contributed towards environmental economics, most notably by his empirical analysis and rigorous work on market-based environmental policy instruments, most notably, emissions trading programs. His first-of-a-kind analysis of the United States Acid Rain Program has established firm empirical evidence supporting the economics and environmental soundness of cap-and-trade mechanisms for environmental issues such as air pollution and global warming (Schmalensee et al., 1998). In this landmark study, experience was documented with how the market-based sulfur dioxide (SO₂) trading program established within the 1990 Clean Air Act Amendments achieved enormous environmental advantages at significantly lower cost than traditional methods by regulation, providing firm evidence supporting environmental governance by markets (Schmalensee et al., 1998; Stavins, 1998). Schmalensee's research significantly helped shape international environmental policy discussions, notably conceptualizing and utilizing global emissions trading systems like the European Union Emissions Trading System (EU ETS), the world's largest carbon market, and regional carbon pricing tools. Relying on empirical analysis that is rigorous and conceptual analysis, Schmalensee's research reinforced institutional beliefs that market-based instruments are effective, clearing the way for acceptability among international institutions, national governments, and regional organizations that trading programs constitute the preferred environmental policy solution (Ellerman, Joskow, & Harrison, 2003; Convery & Redmond, 2007).

Moreover, Schmalensee's pioneering work directly influenced thinking and reporting for policy at the international level, including the United Nations Development Programme's (UNDP) Human Development Reports (HDRs). Indeed, HDRs from the latter 1990s until the 2000s typically cited successful experience with market-based mechanisms responding to environmental externalities and climate change and, consequently, perpetuating concern with economic efficiency in their agendas for sustainability (UNDP, 1998, 2007).

However, Schmalensee's approach itself has been criticized. Ecological economists have argued that emission trading hardly at all tackles equity issues, systemic environmental dangers, and distributional impacts and advocate instead for fuller, ethically-based,

and environmentally appropriate policy instruments (Spash, 2010; Martinez-Alier, 2002; Vatn, 2005). Regardless of such criticisms, Schmalensee's work is immensely influential and has had continuing bearings upon policy debate and institutional practice regarding market-based methods toward environmental challenges.

4.1.2.8 Kenneth Arrow (1921–2017). Kenneth Arrow greatly influenced environmental economics with his landmark work in welfare economics, decision-making within uncertainty, and intergenerational equity. His contributions toward social choice theory, most prominently the impossibility theorem, exposed profound challenges with aggregating individual preferences into collective social welfare functions that have first-order bearings directly toward environmental decision-making, public policy, and valuation frameworks (Arrow, 1951; Arrow, Sen, & Suzumura, 2010). Arrow's contribution essentially defined the economics regarding public goods, market failures, and collective decision-making by highlighting the role of institutional arrangements and social justice considerations during environmental resource and externality management (Arrow, 1971; Arrow & Fisher, 1974). Particularly influential was Arrow's classic analysis of decision-making under uncertainty that emphasized precautionary approaches and adaptive policy formation with environmental risk, irreversibility, and ecological ambiguity (Arrow & Fisher, 1974). His thought regarding uncertainty and irreversibility significantly influenced approaches for cost-benefit analysis and environmental valuation and encouraged prudence and adaptability when dealing with long-term environmental issues such as global warming, biodiversity loss, and natural resource depletion (Arrow, Cropper, Eads, et al., 1996; Arrow & Fisher, 1974).

Additionally, Arrow contributed greatly towards understanding intergenerational equity by advocating due ethical consideration for sustainability and fair treatment for future generations during environmental decisions (Arrow, Dasgupta, Goulder, Mumford, & Oleson, 2012). His argument concerning discounting within intertemporal valuation served to structure learned debates and institutional policy with respect to sustainability and economics of climate, and that served to impact institutions like the World Bank, OECD, and the UNDP, particularly human development reports that addressed equity and sustainability (UNDP, 2011; UNDP, 2014).

Arrow's intellectual work remains influential in international policy discussions, notably his emphasis on balancing economic efficiency, equity, and environmental precaution. His integrative thinking established influential analytical pillars repeatedly referenced during HDR discussions over sustainable human development, the management of climate risk, and intergenerational welfare, significantly informing contemporary international sustainability paradigms (UNDP, 2011; Stern, 2007).

4.1.2.9 Conclusion of Environmental Economics Contributions. These scholars collectively shaped environmental economics into an influential and powerful paradigm among international sustainability discourses. Their earliest efforts significantly shaped international policy regimes and institutions by advancing pragmatic, market-based solution orientations toward environmental matters. Pigou's (1920), Coase's (1960), and Nordhaus's (1992, 2018), among many others, pioneered and elaborated critical ideas such as externalities, internalization measures, and cost-benefit analysis. These economics tools saw widespread application by international institutions such as the World Bank, the Organisation for Economic Co-operation and Development (OECD), and United Nations Development Programme (UNDP), and thereby exerted considerable influences over the earliest sustainability agendas embodied by the Human Development Reports (HDRs) of the 1990s and early 2000s (UNDP, 1992, 1996, 1998, 2000, 2003). Particularly important was the emphasis given to internalizing environmental externalities through the deployment of market-based instruments like emissions trading systems and Pigouvian taxes (Baumol & Oates, 1988; Schmalensee et al., 1998; Stavins, 1998). These instruments themselves played an important role in informing early international environmental and climate policy, which displayed a marked institutional inclination toward incremental adjustments of policy, monetary valuation methods, and economic efficiency (Nordhaus, 2018; World Bank, 2011). The paradigm of weak sustainability that was encouraged by economists like Solow (1991) and Pearce (1993) only served to reinforce the conceptual cohesion with mainstream economics approaches, with a concentration on substitutability between humanmade capital and natural capital and environmental resource valuation.

Such conceptual bases and policy instruments significantly shaped the UNDP's earliest responses toward sustainable development, embodied by earlier HDRs that promoted green

national accounting, environment-adjusted net savings, and environmentally-corrected GDP measures of progress (UNDP, 1996, 1998, 2000). Such economic methods enabled practical and operationally straightforward approaches that could be incorporated with ease within common governance structures, cementing environmental economics' dominance within international policy formulation related to sustainability during the latter part of the 20th century.

But despite their widespread application institutionally, they have come in for serious criticism, by and large from ecological economists, for insufficient attention to deeper ecological limits, distributive justice, and systemic risk (Daly, 1996; Martínez-Alier, 2002; Spash, 2012). Recent HDRs increasingly acknowledge such criticism, agreeing that market-based methods alone and monetary valuation frameworks are inadequate to address such deeply complex sustainability challenges as biodiversity erosion, climate change, and ecological thresholds (UNDP, 2011, 2020).

Thus, this critical analysis supplies foundations for future research by ecological economics scholars, whose contrasting paradigmatic offerings underscore biophysical realism, ethical pluralism, and systemic resilience. The comparison between these two paradigms—environmental and ecological economics—offers an exhaustive analytical frame with which progressing sustainability discourses and their ramifications for global human developmental policy agendas might be understood.

4.1.3. Influential Scholars in Ecological Economics

Ecological economics emerged onto the scene in the latter part of the 20th century responding and critiquing orthodox neoclassical economics with the objectives of integrating ecological thinking, biophysical limits, moral pluralism, and systems thinking into economics (Costanza, 1989; Daly, 1996; Spash, 2012). Leading figures such as Nicholas Georgescu-Roegen, Herman Daly, Robert Costanza, Joan Martinez-Alier, Kate Raworth, Tim Jackson, Clive Spash, and Marina Fischer-Kowalski had effectively transformed the manner we economically think with ideas at the core of present sustainability

debates. Nicholas Georgescu-Roegen (1906–1994) significantly contributed to ecological economics by introducing thermodynamics, and most importantly, the entropy law, into the arena of economic analysis. In his seminal work *The Entropy Law and the Economic Process* (1971), Georgescu-Roegen argued that the economic process is circumscribed by the second law of thermodynamics, which makes eternal economic growth physically impossible (Georgescu-Roegen, 1971). His conceptualization of entropy introduced biophysical bounds into the corpus of economic theory that essentially criticized growth-based assumptions forming the foundation of orthodox economics and provided a significant scientific foundation for ecological economics (Daly, 1991; Martinez-Alier, 2002).

Extending directly from Georgescu-Roegen, Herman Daly (1938–present) greatly expanded ecological economics with his concept of strong sustainability and steady-state economics. Daly argued specifically that ecological limits must set the scale of the economy, instead of merely being controlled by substitutable capital or market forces (Daly, 1991, 1996). His idea of a steady-state economy promotes maintaining a stable level of resource throughput within the world’s ecological carrying capacity with an emphasis on preserving ecological integrity and long-term resilience at the cost of short-term economic growth (Daly, 1996; Daly & Farley, 2010). Daly’s critique emphasized the need for maintaining essential natural capital, recognizing ecological functions as non-substitutable and essential for sustaining human well-being over time (Neumayer, 2010).

Robert Costanza (1950–present) contributed significantly to ecological economics by first pioneering valuation of ecosystem services and their use in economic decision-making. His landmark 1997 study provided a planetary valuation of ecosystem services, estimating their staggering economic contributions and marking their systemic exclusion from conventional economic accounting (Costanza et al., 1997). Costanza’s interdisciplinary thinking centered the intrinsic value of ecological functions, advancing the conceptual basis of sustainability by directly considering ecological contributions outside market-based metrics (Costanza, de Groot, Braat, & Kubiszewski, 2014). His work significantly influenced international policy arenas by demanding broader institutional recognition

of ecosystem services by global measures of sustainability, such as the United Nations Development Programme's (UNDP) most recent Human Development Reports (UNDP, 2011, 2020).

Joan Martinez-Alier (1939–present) contributed to ecological economics by highlighting environmental justice concerns, ecological distribution conflicts, and the social dimensions of sustainability. Martinez-Alier stressed how environmental burdens predominantly affect marginalized groups and addressed these issues by conceptualizing the “environmentalism of the poor” (Martinez-Alier, 2002). His work significantly criticized market environmental valuation by proposing a pluralistic approach with ecological, social, and ethical perspectives, particularly regarding global North-South inequalities and ecological debt (Martinez-Alier, Pascual, Vivien, & Zaccai, 2010).

Kate Raworth (1970–present) took it one step further with environmental economic thought with her seminal “Doughnut Economics” model. Raworth's framework reveals room for equitable and sustainable economics between planetary and social boundaries and intentionally refrains from conventional growth-based methodologies (Raworth, 2017). The model intertwines planetary boundaries with critical human needs and offers an integrative vision for sustainability and common human progress that has gone on to shape contemporary policy discussions and most recent HDR reports (UNDP, 2020).

Tim Jackson (1957–present) contributed to ecological economics by critiquing consumer culture and arguing for prosperity without growth. In his influential book *Prosperity Without Growth* (2009), Jackson argued that there ought to be a reframing of prosperity along ecologically sustainable lines, social justice, and human well-being irrespective of continued economic growth (Jackson, 2009). His argument that human flourishing ought to be disconnected from throughput helped create a secure intellectual foundation for post-growth and degrowth movements informing contemporary sustainability policy (UNDP, 2020).

Clive Spash (1962–present) has significantly contributed to ecological economics with his critical examination of market valuation methods and his advocacy for an environ-

mental decision-making framework that is ethical and deliberative. Spash opines that the economic valuation methods are wanting with regard to addressing complex ecological interdependencies, uncertainty, and moral questions, instead proposing pluralistic, participatory, and deliberative approaches (Spash, 1999, 2012). His research has upheld ecological economics' critical stance against mainstream economic approaches, informing contemporary policy debates on sustainability governance.

Marina Fischer-Kowalski (1946–present) contributed greatly with her work on social metabolism and industrial ecology, emphasizing the biophysical basis of economic activity. Fischer-Kowalski explored the metabolization by human societies of natural resources, providing important empirical instruments for studying the material and energetic basis of the economy, required for the operationalization of policy for sustainability (Fischer-Kowalski & Haberl, 2007; Haberl et al., 2019). Collectively, these scholars have significantly advanced ecological economics and virtually revolutionized the sustainability debates globally by emphasizing biophysical limits, distributive justice, resilience, and alternative visions of economics. Despite disciplinary opposition from dominant traditions of economics, their intellectual work significantly informs global sustainability efforts, notably HDRs released since 2015 that espouse ecological realism, rigorous sustainability, and systemic thinking (UNDP, 2015, 2020).

4.1.3.1 Nicholas Georgescu-Roegen (1906–1994). Nicholas Georgescu-Roegen significantly changed the way we think economically by introducing thermodynamics, and particularly entropy, into the economics intellectual sphere. His seminal work, *The Entropy Law and the Economic Process* (1971), criticized mainstream neoclassical economics by arguing that economic processes are irreversible and entropic and therefore challenged the fallacy of endless growth and absolute substitutability of resources (Georgescu-Roegen, 1971). Georgescu-Roegen's thought provided theoretical precursors for ecological economics with renewed concerns for biophysical realism and absolute bounds defined by energy and matter barriers (Costanza et al., 1997; Daly, 1996). His critique of growth-oriented traditions directly facilitated the emergence of such ideas as strong sustainability and degrowth, actually reshaping intellectual discussion toward acceptability of ecological thresholds and systemic barriers (Martínez-Alier, 2002; Spash,

2012; Raworth, 2017). Despite having initially gone unnoticed by orthodox economics, thinking by Georgescu-Roegen increasingly found a following within sustainability discourses, powerfully influencing future UNDP Human Development Reports (HDRs). Notably, HDRs during the 2010s included thinking on ecological limits, exhaustion of resources, and irreversible environmental degradation, echoing the legacy of Georgescu-Roegen by warning against systemic short-sightedness in production and usage that jeopardizes long-term human development (UNDP, 2011; UNDP, 2014; UNDP, 2020). In particular, the HDR for 2011 emphasized dangers created by violating biophysical thresholds, echoing the seminal ecological economics principle developed by Georgescu-Roegen that long-term sustainability cannot contravene the finite nature of ecological resources (UNDP, 2011; Ecological Economics Influence on UNDP Human Development Reports, 2000–2009, 2010–2015). Georgescu-Roegen’s theoretical work accordingly established intellectual foundations essential for current-day ecological economics viewpoints, implicitly informing emerging global sustainability discourses.

4.1.3.2 Herman Daly (1938–present). Herman Daly has widely been viewed as founder of ecological economics and has had significant influence within global sustainability discussions through his seminal concepts of the *steady-state economy* and *strong sustainability*. Daly was critical of neo-classical presumptions of unlimited economic growth, substitutability between amenities and resources, and annual resource extraction, most significantly within influential books like *Steady-State Economics* (1991) and *Beyond Growth: The Economics of Sustainable Development* (1996) (Daly, 1991, 1996). Main points within Daly’s case involved awareness of ecological limits and that economic activity must remain within such biophysical limits to achieve long-term ecological integrity and human well-being (Daly, 1996; Costanza et al., 1997). Daly’s conception of throughput-limited economics—materials and energy going through the economy—advanced an entirely different economics rationale aimed at maintaining the size of the economy within planetary carrying capacities (Daly, 1996; Farley & Daly, 2010). His conception toppled prevalent growth-based methods widespread in earlier policy debates over sustainability and opened the way for policy frameworks that included ecological thresholds, resilience, and equity at their center. His policy recommendations for ecologi-

cal taxes, ceilings for resource use, and redistribution mechanisms encouraged integrating sustainability into the economics rather than thinking about it at the margin (Daly & Cobb, 1989; Daly, 1991).

Daly's influential ideas have increasingly gained traction in international sustainability policy, most notably apparent within present Human Development Reports (HDRs). For instance, the 2011 HDR, *Sustainability and Equity: A Better Future for All*, and the landmark 2020 HDR, with a special emphasis on the Anthropocene, evidence institutional acknowledgment of Daly's principles by confirming the need for only immediate respect for biophysical limits, correction of ecological overshoot, and distributive justice priorities (UNDP, 2011, 2020). These reports significantly recognize Daly's criticisms by directly addressing growth-based paradigms and prompting systemic adjustments that enshrine human development with ecological limits (UNDP, 2014, 2020).

Therefore, Daly's theoretical contributions and policy argumentation established seminal intellectual foundations for integrating ecological realism and ethical pluralism into global governance for sustainability, effectively recasting contemporary ecological economics and shaping institution-based arrangements embodied by the emerging narratives of HDRs.

4.1.3.3 Robert Costanza (1950–present). Robert Costanza is a seminal scholar whose research actually defined ecological economics by rigorously conceptualizing and putting prices on the value of ecosystem services. His seminal co-authored publication, *The Value of the World's Ecosystem Services and Natural Capital* (Costanza et al., 1997), significantly transformed the conceptualization of environmental-economic interactions by rigorously assigning figures to ecological services that are otherwise not included in regular economics accounts. The seminal study starkly revealed the enormous economic and intrinsic value of ecosystems, thereby increasing broader institutional visibility and uptake of ecosystem services approaches among international policy discussions (Costanza et al., 1997; Costanza et al., 2014). Costanza's research provided us with valuable tools for integrating ecological integrity into economics, making it possible to use natural capital accounting and establish planetary measures of sustainability. His models challenged

prevailing economics that undervalue or do not consider ecological inputs, maintaining that sustaining ecological systems is part of human well-being (Costanza et al., 2014; Costanza, Cumberland, Daly, Goodland, & Norgaard, 1997).

Moreover, Costanza's extensive body of work on resilience, ecological thresholds, and adaptive governance emphasized the interdependent interlinkages between human socio-economic systems and ecological integrity, deepening policy arenas on sustainability even more (Costanza, Graumlich, & Steffen, 2007; Costanza & Daly, 1992). His work has greatly enriched prevailing United Nations Development Programme (UNDP) Human Development Reports (HDRs), most pronouncedly visible in the shift toward ecological realism and integrative ecosystem-based valuation methods, such as reflected in the discussions by the 2011, 2014, and 2020 reports (UNDP, 2011, 2014, 2020).

Thus, Costanza's theoretical contributions and methodological advances significantly impacted institutions by demanding the integration of ecological values and resilience-based thinking within planetary sustainability governance, offering seminal intellectual foundations for contemporary ecological economics frameworks enshrined in increasingly transformed HDR narratives.

4.1.3.4 Joan Martinez-Alier (1939–present). Joan Martinez-Alier has significantly impacted ecological economics with his pioneering synthesis of political ecology, environmental justice, and pluralistic valuation methods. In his influential work, *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation* (Martinez-Alier, 2002), he critically assessed orthodox valuation methods by arguing that monetary measures only are inadequate for understanding the diverse social, cultural, and ecological values central to environmental conflicts. Martinez-Alier emphasized diverse valuation vocabularies—in monetary units, but ranging over to culture-based identity, livelihood security, and sacredness—emphasizing that ethical pluralism and social justice considerations should enter into decision-making processes within economics (Martinez-Alier, 2002; Martinez-Alier, Temper, Del Bene, & Scheidel, 2016). It brought forth ecological distribution struggles and illuminated how environmental degradation damages the poor and the Global South more than the rest, effectively broadening the normative vision of

ecological economics to directly include equity and distributive justice issues (Martinez-Alier et al., 2016; Martinez-Alier, Pascual, Vivien, & Zaccai, 2010). In ideas such as ecological debt and environmentalism of the poor, Martinez-Alier has encouraged policy measures that observe and correct past injustices in extractive industries, environmental impacts, and connected socio-economic consequences (Martinez-Alier et al., 2016; Martinez-Alier, 2009).

Martinez-Alier's thought has increasingly influenced international sustainability policy discussions, most apparent among new United Nations Development Programme (UNDP) Human Development Reports (HDRs). HDRs from 2011 onward, particularly reports released in 2011, 2014, and 2020, reflect greater attention for equity, distributive justice, and varied valuation methods, representing intellectual impact by Martinez-Alier upon current global sustainability thought (UNDP, 2011, 2014, 2020).

Therefore, the intellectual contribution of Martinez-Alier significantly helped ecological economics by prioritizing social equity, environmental justice, and the necessity for pluralistic valuation methods, with critical foci for the integration of ethical and normative viewpoints with sustainability governance.

4.1.3.5 Kate Raworth (1970–present). Kate Raworth has managed to gain significant prominence among planetary sustainability and ecological economics debates with the creation of “Doughnut Economics,” which is an original visual framework that intersects planetary boundaries and socially necessary pillars with the creation of a “safe and just operating space” for humankind (Raworth, 2017). Raworth's framework straightforwardly sits economic activity between environmental thresholds and social justice, emphasizing that just as economic activities must be contained within environmental limits, concurrently, there are the requirements for fulfillment of basic human needs and rights such as education, health, nutrition, water, and political representation (Raworth, 2012, 2017). It seriously challenges reigning orthodox thinking about endless growth, instead demanding such economies that are deliberately designed to thrive without breaking ecological ceilings nor falling below social floors. Holistic conceptualization by Raworth has greatly influenced contemporary discussions about sustainability by promoting systemic, integra-

tive thinking about economic and environmental problems and that resilience, distributive justice, and ecological integrity are connected, not separate issues (Raworth, 2017; Dearing et al., 2014; O'Neill, Fanning, Lamb, & Steinberger, 2018).

Raworth's impact becomes more apparent at the global level with policy agendas centered on sustainability, notably Human Development Reports (HDRs) from the United Nations Development Programme (UNDP), like their 2020 HDR, *The Next Frontier: Human Development and the Anthropocene*. Here, planetary pressures are explicitly mentioned alongside resilience, social equity, and the interlinkages between ecological and social systems (UNDP, 2020). Additionally, HDRs since 2014 increasingly highlight the need for comprehensive approaches that consider ecological boundaries alongside human well-being, reflecting the model of Doughnut Economics directly (UNDP, 2014, 2020).

Therefore, Raworth's seminal conceptualization of Doughnut Economics provides an elegant, uniting narrative that significantly extends ecological economics and molds world sustainability governance, informing contemporary efforts at reshaping sustainable human development beyond orthodox growth paradigms.

4.1.3.6 Tim Jackson (1957–present). Tim Jackson has significantly shaped ecological economics and sustainability discussions at the global level with his influential criticism of growth paradigms and advocacy for alternative visions emphasizing human well-being and ecological integrity. In his seminal work, *Prosperity without Growth: Economics for a Finite Planet*, Jackson (2009) critically examines the assumptions at the core of prevailing growth-based economics, chief among them the common utilization of GDP as an indicator of societal progress. He persuasively advocates for transitioning toward steady-state economies prioritizing quality of life, social justice, environmental sustainability, and equity instead of perpetually increasing accumulative material growth and consumer culture (Jackson, 2009, 2017). Critical remarks by Jackson are significantly shaped by ecological threshold, distributive justice, and thinking on resilience, emphasizing systemic unsustainability ingrained in untamed pursuit of economic growth. He espouses the notion of conceptualizing prosperity divorced from material throughput with the proposition that genuine human prosperity is achievable within planetary boundaries with policy

regimes that are focused on sufficiency, equalized sharing of resources, reduced inequality, and sustainable lives (Jackson, 2009; Jackson & Victor, 2019).

Jackson's paradigm-breaking idea increasingly comes up in international sustainability policy documents, particularly Human Development Reports (HDRs) by the United Nations Development Programme (UNDP), most recently since 2014. For instance, HDRs since 2014 directly refer to vulnerabilities, resilience, social justice, and environmental limits, which is consistent with Jackson's promotion of economies aimed at prosperity without the necessity of sustained economic growth (UNDP, 2014, 2020). The HDR for 2020 particularly emphasizes human development's necessity of being recast within planetary bounds, testifying increasing salience of Jackson's line of argument within mainstream institution-based discourses (UNDP, 2020).

Therefore, Jackson's work provides important intellectual foundations for perennial debates on sustainable human development, informing institution-based narratives and policy strategies significantly through support for systemic shifts toward sustainability, sufficiency, and resilience as pillars of economic well-being and environmental integrity.

4.1.3.7 Clive Spash (1962–present). Clive Spash has significantly impacted ecological economics with his critical analysis of conventional market-based approaches and the need for ethical pluralism and deliberation procedures in environmental valuation and sustainability governance. Central to Spash's body of research is the argument that environmental challenges cannot be adequately addressed with narrow economic tools like cost-benefit analysis because they are accustomed to ignoring deeper ecological nuance, ethical considerations, social justice, and the inherently moral values of nature (Spash, 1999, 2008, 2012). It was Spash (1999) who criticized simplistic utilitarian assumptions behind common economists' approaches with his seminal piece "The Development of Environmental Thinking in Economics." His argument was that mere monetary valuation of ecosystems has the effect of leaving out important ethical, cultural, and ecological dimensions. Furthermore, with his influential article "New Foundations for Ecological Economics," Spash (2012) encouraged ecological economics toward genuine interdisciplinary collaboration, ethical pluralism, and deliberative democracy that takes cognizance

of diverse societal values besides market valuations.

Deliberative environmental valuation is Spash's intellectual argument for decision-making that should be participatory and democratic at the environmental level. Spash insists that sustainability governance is most effective with ethical thought, openness by the public, and acceptance of various knowledge systems, and therefore advocates an enriched, fuller decision-making framework that has extensive similarity with new sustainability narratives in contemporary Human Development Reports (HDRs) (Spash, 2007, 2012; UNDP, 2011, 2020).

Most recent HDRs increasingly reflect Spash's advocacy by identifying pluralistic values, participatory governance, and ethics as essential for addressing complex ecological and sustainability challenges. In particular, the 2011 HDR on Sustainability and Equity and the 2020 HDR with emphasis on the Anthropocene explicitly underline the necessity for inclusive and deliberative arrangements, foreshadowing more broadly the acceptance by global sustainability policy of Spash's critical claims (UNDP, 2011, 2020).

Thus, Clive Spash's scholarship has contributed to the theoretical strength of ecological economics, profoundly influencing present sustainability discourses and institutions toward more inclusive, ethically conscious, and participatory environmental governance and policymaking.

4.1.3.8 Marina Fischer-Kowalski (1946–present). Marina Fischer-Kowalski has significantly contributed towards ecological economics with path-breaking work on socio-metabolic regimes, material flow analysis (MFA), and sustainability transitions. Most of her work compares socio-ecological systems analysis, historical trends in the utilization of materials and energy, and systemic perspectives towards sustainability transitions, proposing the significant role that societal metabolism has towards shaping long-term ecological and social trajectories (Fischer-Kowalski & Haberl, 2007; Fischer-Kowalski, 2011). Fischer-Kowalski's influential book, *Socioecological Transitions and Global Change*, co-authored with Helmut Haberl, undertakes comprehensive theoretical and empirical analysis of socio-metabolic regimes both past and present, emphasizing how different modes of

production and patterns of consumption have profound environmental sustainability consequences (Fischer-Kowalski & Haberl, 2007). The socio-metabolic school of thought emphasizes the systemic connection between ecological sustainability and society's resource use by arguing that sustainability transitions are initiated by transformative societal changes in energy and material throughput rather than incremental changes (Fischer-Kowalski, 2011; Fischer-Kowalski et al., 2011).

Fischer-Kowalski's thought has greatly influenced world policy thinking on sustainability, particularly for latter Human Development Reports (HDRs). The rising reference in HDRs to systemic transformation, planetary boundaries, and socio-metabolistic thinking is a clear sign of intellectual influence. Specifically, HDRs in the past few years ever more emphasize the necessity for transformative systemic transformation in resource usage patterns, following methodologies equivalent to Fischer-Kowalski's material flow and socio-metabolistic analysis (UNDP, 2011, 2020).

Moreover, the integrative approach by Fischer-Kowalski has resulted in MFA's global adoption as a critical analytical tool for sustainability governance, having profoundly influenced policy agendas at international institutions such as the United Nations Environment Programme (UNEP) and the European Union (EU), whose policymaking increasingly makes use of MFA for analysis toward sustainability and policy formulation (Fischer-Kowalski et al., 2011; Krausmann et al., 2009).

On the whole, Marina Fischer-Kowalski's comprehensive and pioneering work significantly enriched ecological economics' analytical ability, enriching contemporary discussions concerning sustainability and global policy agendas by emphasizing the critical need for widespread, systemic alterations in societal resource use and governance structures.

4.1.3.9 Conclusion of Ecological Economics Contributions. Individually and together, these prominent scholars of ecological economics have considerably altered the intellectual and normative shape of global sustainability discourses. Their criticisms of unlimited growth (Georgescu-Roegen, 1971; Jackson, 2009), their concerns with biophysical realism and thermodynamic constraint (Daly, 1996; Fischer-Kowalski, 2011), and their in-

tegrations of ethical pluralism, environmental justice, and systemic resilience (Martínez-Alier, 2002; Spash, 2012; Raworth, 2017) have increasingly found their way into international policy agendas. Their influence becomes ever more evident across the Human Development Reports (HDRs) of the past two decades (UNDP, 2011; UNDP, 2020), which increasingly embed ecological limits, equity, and multidimensional well-being into sustainability agendas. Ecological economics, with the seminal work by Georgescu-Roegen, Daly, Costanza, and their intellectual progenies, challenges prevailing economics by rejecting growth dependency and demanding transformative adjustments toward resilient sustainability (Daly, 1991; Costanza et al., 1997), systemic governance (Spash, 1999), and identification of socio-metabolic and ecological bounds (Fischer-Kowalski, 2011). Their literature provides the foundation for critical examination of market-based methods and spawns integrative visions with foundations in justice, sufficiency, and resilience—charting out avenues toward recasting sustainable human development for the Anthropocene (Raworth, 2017; Hickel, 2020). In the ultimate analysis, ecological economics becomes not only a scientific discipline but also a normative project that enshrines ecological integrity, equity, and ethical governance at the core of sustainability transformations.

4.1.4. Influential Scholars in Marxian Ecological Economics

The incorporation of a distinct section on Marxian ecological economics is motivated by the need to identify an alternate and critical line of ecological thinking that diverges both from neoclassical environmental economics and orthodox ecological economics. Informed by classical Marxist political economy, the perspective—developed prominently by authors such as Foster (2000), Burkett (2006), and O'Connor (1998)—interprets ecological disasters as systemic byproducts of capitalist methods of production, accumulative practices, and dis-embedding from nature. In contrast with market-based approaches or even with biophysical thinking, the Marxian ecological perspective highlights the metabolic rift between nature and capital, focusing on disarticulations between ecological sustainability and the logic of constantly accumulating capital. Its value for this dissertation is that it might uncover the structural failures of dominant policy discourses, includ-

ing HDRs, and offer a deeper-level historic-material critique of how nature, sustainability, and development are co-constructed within capitalism. Marxian ecological economics undertakes a deep structural critique of capitalism, revealing the builtin ecological contradictions with new original concepts such as Marx's *metabolic rift*. Karl Marx established the intellectual foundation by identifying the disruption of the "metabolism" between human society and nature by capitalism—in agricultural and extractive structures—leading to ecological destruction and deviation from natural processes (Marx, 1867/1976). This idea was first restated by John Bellamy Foster, who developed systematically the theory of the metabolic rift, describing capitalist accumulation as being the main culprit for ecological crisis, such as climate change, soil depletion, and destruction of biodiversity (Foster, 2000, 2013).

Paul Burkett (1999, 2005) expanded these remarks further by introducing ecological dimensions into Marx's value theory of labor, arguing that natural conditions have a constitutive role within capitalist production but are systematically devalued and externalized. Burkett demonstrated that Marx's materialism contains within it the foundations for thinking both economic value and environmental destruction as interrelated crises within capitalism.

James O'Connor (1998) took it one step further by sketching out the "second contradiction of capitalism," which holds that environmental destruction undermines the ecological and social bases necessary for capital accumulation itself—thereby generating systemic instability.

Jason W. Moore (2015) advanced scholarship with his world-ecology framework, which emphasizes capitalism as a world-ecological regime with a long past that weaves together nature and society with labor, power, and extraction. Moore criticizes dualistic thinking and reveals how capital accumulation recurrently remolds nature at different spatial and temporal scales.

Kohei Saito (2017), by deep archival work, discovered that Marx's later work exhibited enormous ecological awareness, correcting prevailing perceptions that had placed Marx

among anthropocentric thinkers. Saito points out Marx's enlarging concern with ecological thresholds and anti-productivist critiques, bringing him into the proto-ecological tradition.

Andreas Malm (2016), on the other hand, gave a historical-materialist interpretation of fossil capitalism, identifying the crisis of anthropogenic warming with the structural reliance of capitalist production on fossil fuel power, and stressing the industrial causes of anthropogenic warming.

Individually and together, these scholars have crafted Marxian ecological economics into a comprehensive theoretical alternative that confronts environmental destruction under capital, connects social and ecological catastrophes, and presses transformative visions for post-capitalist, ecologically sustainable futures. Their work increasingly is seen in broader ecological economic debates and sustainability discourses, for example, Human Development Reports issued recently that tentatively mirror systemic criticisms and post-growth necessities.

4.1.4.1 Karl Marx (1818–1883) and the Ecological Foundations of Metabolic Critique. While Karl Marx is not traditionally situated within the line of ecological economics, his dialectical materialism and critical examination of capitalist production provided important intellectual foundations for contemporary Marxian ecological economics. Central to Marx's ecological viewpoint is his formulation of the *metabolic rift*, first most elaborately worked out by him in *Capital, Volume I* (1867) and even prior to that in his *Grundrisse* and letters exchanged with Engels (Marx, 1867; Marx, 1973). The metabolic rift refers to the disarticulation of socio-ecological metabolism, the material and energetic exchanges between human societies and nature, under conditions of capitalist relations of production. Marx revealed how capitalist agriculture, in pursuit of surplus value, disrupts nutrient cycles by removing soil fertility without replenishment, with the effect of creating ecological disarrays at the very heart of economic build-up (Foster, 2000; Burkett, 1999). Marx's environmental visions have sometimes remained invisible during most of the 20th century, when his work was interpreted through productivist and industrialization-based readings. However, scholars such as John Bellamy Foster, Paul Burkett, and Kohei Saito

have reread Marx's thought in such a way that they bring out of his mature work an enduring ecological critique (Foster, 1999; Burkett, 2006; Saito, 2017). Foster (2000) formulated the metabolic rift rigorously as an original ecological concept based on Marx's historic materialism, referring it to modern-day catastrophes such as soil impoverishment, deforestation, and climatic changes. Burkett (1999, 2005) emphasized that Marx's theory of value founded on labor presupposed by itself a nature-based foundation for production and that his concept of use-value included ecological thinking.

Kohei Saito's analysis of Marx's posthumous notebooks (so-called *Exzerptheften*) from archives revealed that Marx actively read ecological and agronomic literature, particularly soil chemistry by Justus von Liebig. Saito (2017) demonstrated that Marx's anxiety over the metabolic unsustainability under capital deepened, and his unpublished notebooks reveal that he pursued more systematic ecological criticism before his death.

Here, Marx's critique of capitalism is not simply that it appropriates labor but that it appropriates nature and resists the capitalist tendency to treat nature itself as a free, unlimited input into the circuit of production. His dialectical thought provides structural understanding why capitalist society, having alienated the worker, actually alienates nature and produces systemic environmental destruction. Marx's sensitivity to nature's agency, the materiality of the circuit of production, and the need for rational, collective control over socio-ecological metabolism provides us with an early theoretical foundation for thinking about sustainability well before his own time.

Environmental relevance of Marx's work, especially by the metabolic rift, is still significant in radical understandings of green capitalism, market environmentalism, and ecological modernization perspectives. It has increasingly gained footing within broader sustainability discourses, e.g., within the conceptual arena of degrowth, eco-socialism, and post-growth movements. Marx's work is omitted from the dominant Human Development Reports (HDRs), but their influence becomes increasingly evident within critical sustainability literature and theoretical critiques of neoliberal developmental models.

4.1.4.2 Paul Burkett (1956–2024). Paul Burkett has given Marxian ecological economics its foundations with his systematic integration of ecological thinking with Marxist value theory and political economy. In his seminal book, *Marx and Nature: A Red and Green Perspective*, Burkett (1999) dispels the widespread picture of Marx as productivist, showing instead that Marx’s value theory and materialist conception of history provide fertile ground for an ecological critique of capitalism. Burkett demonstrates that Marx thought of nature and labor as co-constituting founts of wealth and that he viewed the biophysical and use-value dimensions of natural processes as constitutive of social reproduction and production (Burkett, 1999; Foster, 2000).

Burkett (1999, 2006) points out that capitalist accumulation is reliant on the treatment of nature as a “free gift,” externalizing environmental costs and resulting in over-exploitation and destruction of ecosystems. This externalization is not an accident but is structurally embedded within capitalist value relations, which are themselves oriented toward exchange-value at the expense of use-value. Burkett extends his analysis by examining how capitalist production undermines socio-ecological reproduction by commodifying nature and turning it into abstract capital, again reinforcing ecological irrationality and crisis tendencies (Foster & Clark, 2009).

Both his chapters for the *Handbook of Ecological Economics* are critical of ecological modernization theory and orthodox environmental economics for their failure to confront the structural contradiction of the capitalist economy. Burkett rejects fixes like carbon trading and green growth, as they merely redescribe the logic of the capitalist economy and inscribe deeper inequality (Burkett, 2005). Burkett instead advocates a socialist ecological transition founded upon democratic planning, ecological rationality, and public control over productive forces (Burkett, 2005; Clark & York, 2005).

Additionally, Burkett’s engagement with thermodynamics establishes a conceptual connection between Marxian political economy and ecological economics. In acknowledgment of Georgescu-Roegen’s focal role for entropy, Burkett (2006) reframes the question of entropy as neither transcendentally given nor absolute constraint but instead histori-

cally reliant upon capitalist processes of production. In that way, Burkett identifies Marx-ian ecological economics concurrently with critique of capitalist ecological irrationality and with normative post-capitalist sustainability (Burkett, 2006; Saito, 2017).

4.1.4.3 James O'Connor (1930–2017). James O'Connor significantly advanced Marx-ian ecological thought with his conceptualization of the “second contradiction of capitalism,” a theory that acknowledges environmental destruction not merely as an externality, but more importantly, as a systemic property that threatens the sustained reproductions of the capitalist economies. Whilst Marx’s “first contradiction” is centered on the exploitative relationship between capital and labor, O'Connor’s “second contradiction” addresses capital’s relationship with its external ecological and societal circumstances—land, labor power reproduction, and public amenities—that he designated the “conditions of production” (O'Connor, 1998). In his opinion, capitalism hurts these very conditions with environmental destruction, deflection of natural resources, pollution, and commodification of ecosystem services, and ends up generating economic crises resulting from ecological rather than merely wage-labor exploitation-based contradictions (O'Connor, 1994). From such logic, capitalist accumulation becomes self-undermining by ruining the biophysical and societal infrastructures upon which it itself depends, and which require greater public intervention to restore these drained circumstances. These interventions, however, inflate public expenditure and precipitate legitimacy crises, increasing pressures within the capitalist regime (O'Connor, 1998). His line of argument previewed that which was to follow with respect to ecological fiscal burden and differential environmental destruction, understanding ecological collapse neither as externality inhibiting capital nor as externality internal to capital, but instead an internality within capital accumulation itself.

O'Connor’s theoretical contributions enabled critical ecological political economy, especially the journal **Capitalism Nature Socialism**, which he co-founded with others with the goal of facilitating interdisciplinary Marxist-ecological scholarship. His work influenced numerous eco-socialist and degrowth scholars who point out the socio-ecological foundation of economic reproduction and condemn the absence of internalization of environmental limits by neoliberalism (Foster, 2000; Burkett, 2006). Furthermore, O'Connor’s dialectical thought predated current discussions in ecological economics and

environmental sociology on the systemic nature of capitalist environmental disasters and the necessity for structural transformation (Foster & Clark, 2016).

His work thus remains at the forefront to synthesize Marxian political economy with ecological crisis theory, contributing immensely toward our contemporary understanding how environmental devastation, fiscal retrenchment, and capitalist reproduction intersect toward generating ecological contradiction and crisis.

4.1.4.4 Jason W. Moore (1971–present). Jason W. Moore has profoundly influenced Marxian ecological economics by developing the “world-ecology” perspective, which re-frames capitalism as an historically co-produced ecological formation. In his magnum opus, *Capitalism in the Web of Life* (2015), Moore holds that nature and society are not separate ontologically distinct arenas nor related but distinct entities, but are instead co-intertwined dialectically by what he identifies “the oikeios”—the active inter-relationality between human and non-human natures within historic capitalism (Moore, 2015). In rupture with orthodox nature/society dualisms, Moore holds that the logic of value expansion immanent within capitalism is really founded rather than upon the creation of surplus value by increasing labor time, but rather by the extraction of “cheap natures”: unpaid or low-paid labor by human labor, non-human organisms, energy, and ecological systems (e.g., unpaid reproductive labor, soil fertility, forests, oceans) (Moore, 2017). Moore’s framework condemns orthodox environmental economics and conventions of ecological economics that disconnect ecological disasters from the logic of capital accumulation at the systemic level. Instead, he frames environmental devastation as an immanent feature of the unfolding historical trajectory and tactics of accumulation of capital and emphasizes that value creation by capital necessitates the continuous restructuring of socio-ecological relationships across space and time. Moore borrows from world-systems analysis, environmental history, and historical materialism to map how different trajectories of capitalist growth (for example, the Dutch Golden Age, the British empire, fossil capitalism) have relied on spatial and ecological fixes that defer looming catastrophes but introduce new contradiction (Moore, 2010; Malm, 2016).

The “world-ecology” approach allows increasingly thorough analysis of how the eco-

conomic, social, and ecological systems evolve alongside one another with the structural necessities of capital and deepens Marxian ecological critique with historical depth and spatiality. Moore's work has experienced significant resonance in the degrowth, eco-Marxist, and post-capitalist sustainability literature, providing a systemic frame with which to think about climatic change, biodiversity loss, and resource depletion as core manifestations of the ecological contradictions of capitalism—in themselves, not anomalies to be fixed by policy.

4.1.4.5 Kohei Saito (1987–present). Kohei Saito has had a transformative influence on Marxian ecological economics through his groundbreaking archival research on Marx's late work. His classic monograph, *Karl Marx's Ecosocialism: Capital, Nature, and the Unfinished Critique of Political Economy* (2017), sheds new lights on previously unnoted ecological dimensions of Marx's work, particularly as developed during the so-called *excrptehefte*—Marx's notebooks of the 1860s and 1870s where he engaged actively with writings on natural sciences, most importantly with Justus von Liebig and Carl Fraas (Saito, 2017). Saito (2017) argues that Marx's thought increasingly focused on issues of soil erosion, agronomy, and sustainability of capitalist agriculture. Saito refers to Marx's awareness with the metabolic rift—a term first found by Foster (1999) and Burkett (1999)—and shows that Marx himself was profoundly concerned with the environmental consequences of capitalist production. Saito declines the productivist interpretation of Marx, rather offering a reconstruction of Marx as ecological limits, sustainability, and metabolic restoration theorist.

Notably, Saito reveals that Marx conceived another mode of production founded on rational regulation of the socio-ecological metabolism, with the respective producers' collective control over natural resources that are sustainably and equitably utilised. Here, Marx fits with the most important pillars of ecological economics like consideration of biophysical limits and necessity for post-capitalist, degrowth-based alternatives (Saito, 2017; Foster & Clark, 2016).

Beyond his scholarly contributions, Saito's work has had considerable contemporary resonance. His subsequent publication *Capital in the Anthropocene* (2020, in Japanese) be-

came a best-seller in Japan, where he further advocates for a degrowth ecosocialist agenda grounded in Marxian theory. He critiques green capitalism and market-based sustainability solutions, arguing that ecological salvation cannot be achieved without systemic transformation of capitalist relations of production (Saito, 2020).

Saito's work is an amalgamation of ecological economics, historical materialism, and sustainability science. His work informs ecosocialist controversies, degrowth literature, and critical approaches towards the Anthropocene by recovering Marxian ecological economics with renewed historicity and contemporaneity.

4.1.4.6 Andreas Malm (1977–present). Andreas Malm is the leading contemporary figure in Marxian ecological economics and political ecology, most renowned for his historically oriented critique of fossil capitalism. His seminal work, *Fossil Capital: The Rise of Steam Power and the Roots of Global Warming* (2016), gives us a rigorous historico-materialist description of how and why capitalism became structurally reliant on fossil fuels (Malm, 2016). In opposition to the techno-deterministic version that fossil fuels were preferred due to considerations of technical efficiency, Malm reveals that 19th-century British capitalists deliberately preferred coal to water power in order to concentrate production and gain greater control over labor—striking a decisive blow that locked industrial capitalism into carbon-intensive regimes of energy. Malm's core argument is that fossil energy was not an inevitable or neutral development but a socio-ecological strategy of capital accumulation, thus establishing a structural link between capitalism and ecological crisis. He contends that the combustion of fossil fuels should be seen as a historically contingent but deeply entrenched outcome of class struggle and capitalist imperatives for control, flexibility, and expansion (Malm, 2016; Malm, 2020).

By locating climate change in the trajectory of historical capitalism, Malm criticizes both environmentalism and elements of ecological economics that frame emissions as an externality instead of as an integral part of capitalist growth. His work has enriched Marxian ecological economics by associating the logic of capital with particular energy transitions, offering an influential framework for conceptualizing present-day climate crisis as more than merely a technical debacle, but instead, as a systemic and historical by-product of

capital accumulation during the fuel age (Foster, Clark, & York, 2010).

Malm adds his contribution furthermore to contemporary debates regarding climate action and the political economy of the decarbonization process. In yet more recent texts like *How to Blow Up a Pipeline* (2021), he advocates for a more militant version of climate activism, based on anti-capitalist theory and direct antagonism towards fossil capital. These texts have stirred controversy amid ecological movements and left-leaning climate politics, setting forth Malm as one of the lead theoreticians of the Anthropocene within historic materialist thought.

Overall, Malm's research is a crucial breakthrough in conceptualizing the energy metabolism of capitalism, connecting ecological economics, historical sociology, and Marxist thought. His research continues to influence radical thinking on the ecological ceiling of capitalism, low-carbon transitions, and the political tactics that lead toward climate justice.

4.1.4.7 Conclusion of Marxian Ecological Economics Contributions. Marxian ecological economics supplies an historically informed and rigorous critical analysis of systemic ecological contradiction within capitalism. Drawing from Karl Marx's original understanding of the metabolic rift, modern scholars like John Bellamy Foster, Paul Burkett, James O'Connor, Jason W. Moore, Kohei Saito, and Andreas Malm have considerably developed Marxian ecological thinking. These scholars have incorporated ecological realism, social theory, and capitalist growth critiques into the realm of ecological economics, thus supplying an alternative critical perspective compared with neoclassical and even orthodox ecological perspectives (Foster, Clark, & York, 2010; Burkett, 1999; O'Connor, 1998; Moore, 2015; Saito, 2017; Malm, 2016). Their work together highlights the intertwined nature of ecological and capitalist catastrophes, arguing that environmental destruction is not an externality but a systemic by-product of capitalist growth dynamics. Their criticism revolves around the structural lack of capacity of capital for sustainable metabolic relationships with nature—relationships that are constantly disrupted by capital's drive for unlimited growth, commodification of ecosystem services, and externalization of environmental liabilities (Foster, 2000; Burkett, 2005; Malm, 2020).

Moreover, these publications question prevailing market-led environmental fixes such as carbon pricing, green growth, and ecological modernization, instead proposing radical alterations in socio-economic arrangements and energy regimes. Their publications have provided intellectual foundations for ecosocialism, degrowth, and post-capitalist approaches to sustainability, all emphasizing ecological integrity, social justice, and democratic ecological governance (Moore, 2017; Saito, 2023).

Marxian ecological economics enriches the larger literature on sustainability by bringing political economy, metabolic analysis, and historical materialism to the forefront. It increasingly provides critical analysis for what the growth limits are, how fossil capital fits into the equation, and why systemic alternatives are necessary that intersect human development with ecological limits.

4.2. PARADIGMATIC TRENDS: FROM MARKET SOLUTIONS TO ECOLOGICAL REALISM

The intellectual and theoretical ideas discussed in previous chapters reflect different and unfolding paradigmatic developments that have influence global sustainability discourses, especially as developed by the *Human Development Reports* (HDRs). The discussion reveals an important shift from the earliest predominance of market-based environmental economics towards increasing recognition and selective incorporation of the systemic critiques and grounding theoretical ideas proposed by ecological economics. This transformation mirrors wider developments within international economic thinking, policy formulation, and sustainability practice, as global institutions increasingly encounter and attempt to address the complicated, interdependent character of ecological and societal systems. During the early 1990s, the dominant approach informing environmental thinking within international developmental discourse was environmental economics—an approach greatly shaped by neoclassical economics. It stressed efficiency in the use of scarce resources, market instruments for internalizing externalities, and the incorporation of environmental factors into cost-benefit analysis. Under this approach, environmental destruction was essentially thought of as a market failure that could be addressed by

devices such as carbon pricing, trading in emissions, or taxes for cleaner technologies. The sustainability challenge was thus recast as an optimization problem that could be addressed with marginal adjustments to prevailing economic arrangements rather than by systemic change (Pearce, Markandya, & Barbier, 1993).

HDRs during the 1990s and early 2000s mostly mirrored this orientation. Sustainable development was encouraged alongside economic growth, presuming compatibility between environmental conservation and economic growth by technological breakthroughs and enhanced market operation. Analytical emphasis continued to stay with national development paths, green GDP, and ecological modernization measures. Yet, this paradigm increasingly encountered serious theoretical and empirical challenges, especially from researchers sympathetic to ecological economics, who claimed that environmental economics overlooked ecological thresholds, biophysical limits, and questions of distributive and intergenerational justice (Daly, 1996).

Starting from the mid-2000s, the deepening reality of planetary ecological crises such as climate change, biodiversity erosion, ecosystem destruction, and resource depletion began to reveal the inadequacies of incremental, market-based fixes. Ecological economics became a more integrative and critical paradigm, one that refused the conversion of ecological systems into monetary measures and put forward the intertwining of social, economic, and environmental processes. HDRs at this time began to reflect such influences more concretely, if unevenly. The incorporation of such ideas as planetary boundaries, ecosystem resilience, and the Anthropocene into narratives of development registered an epistemological shift from technocratic optimism toward what might be called “ecological realism” (Rockström et al., 2009; Steffen et al., 2015).

This paradigmatic transition remains ongoing and contested. While many HDRs now incorporate systemic language and visualizations from ecological economics, such as circular economies and social-ecological resilience, these are often embedded within frameworks that still valorize economic growth. Thus, a hybrid discourse has emerged: one that seeks to balance ecological constraints with developmental imperatives but remains reluc-

tant to embrace the more radical implications of ecological economics—such as limits to growth, degrowth pathways, or alternative welfare metrics beyond GDP.

Thus, the developmental trajectory from market-oriented environmental economics to more balanced ecological realism among HDRs is aligned with the broader contradiction between technocratic sustainability and critical ecological thought. It is a humble but profound reconsideration of development paradigms with the ever-growing evidence that socio-economic well-being and ecological integrity are harmoniously connected but fundamentally co-dependent. The future long-term influence of ecological economics in recasting sustainability discourses globally is probably conditioned by how these contradictions are addressed within new development architectures.

4.2.1. Phase I: Foundational Human Development with Minimal Environmental Integration (1990–1999)

It is the inaugural phase for the *Human Development Reports* (HDRs), where the notion of sustainable development was first recognized in international developmental thinking, yet environmental concerns stayed peripheral. Environmental questions were mentioned mostly with reference to ethical, humanitarian, or distributive considerations—captured, for instance, within wider assurances with respect to equity and intergenerational justice—but they have yet to be institutionally inscribed within the conceptual centerpiece of human development. The overarching concern with HDRs of the 1990s was human capabilities and freedom expansion, with conceptual reference to Amartya Sen’s capability approach and the broader rights-based approach of the UNDP (Sen, 1999; UNDP, 1990). Ecological systems, energetic fluxes, and throughput of materials barely appeared within the analytical perspective of the earliest HDRs. The environment was afforded an indirect treatment as backdrop or dormant reservoir of resources for growth, rather than active system with integrity, boundaries, and co-dependency with human systems. Even sustainable human development was mentioned only at the conceptual level—as with the discussion by the 1994 HDR of “sustainability across generations”—without rigorous ecological basis or biophysical indicators (UNDP, 1994). In place of systemic limits or environmental

thresholds, sustainability was conceptualized within the frameworks supporting human progress, livelihoods, and institutions.

This exclusion was in line with broader trends in international policy at that point. Despite the 1992 Earth Summit and the introduction of Agenda 21, most of the institutional sustainability literature at that point remained within the environmental economics paradigm, which viewed environmental degradation primarily as an correctable market imperfection. The HDRs of the earliest years accordingly refrained from adopting the more heterodox understanding of ecological economics, which itself only recently had come to question the prospect of endless growth, the substitutability of the stock of natural capital, and the neglect of thermodynamic constraint within economics analysis (Daly, 1996; Martinez-Alier, 1987).

The concept of “human development” in this phase prioritized social outcomes over ecological inputs. Health, education, life expectancy, and income were foregrounded, with the Human Development Index (HDI) becoming the principal metric for measuring developmental success. Environmental indicators were not systematically integrated into the HDI or its extensions. This analytical disjunction allowed for a narrative in which development and environmental degradation could be simultaneously pursued, as long as the former was equitably distributed and human-centered.

However, this earliest period established important conceptual foundations. It enshrined the priority of equity, agency, and well-being—values that would find their place at the center of more comprehensive understandings of sustainability at a later time. The terminology of “needs,” “freedoms,” and “empowerment” initiated here provided a normative space through which environmental issues would be gradually brought into future conceptualizations. In this phase, by contrast, ecological economics was institutionally marginal and biophysical limits had yet to be understood as constitutive human development itself.

4.2.2. Phase II: Dominance of Environmental Economics and Market-Based Integration (2000–2009)

Between 2000–2009, the *Human Development Reports* (HDRs) reflected more and more the predominance of environmental economics within international sustainability conversation. The years encompassed a move away from the moral and human-centered environmental problems that had predominated during the 1990s toward technocratically focused, instrumentally designed policy choices with their foundations in neoclassical economics. At the center of the model was that environmental destruction was a market failure that could be rectified with appropriate economic instruments (Pearce, 1993). Market instruments like Pigouvian taxes, trading systems of emissions, and payment for ecosystem services (PES) emerged as effective instruments for internalizing environmental externalities. These instruments became increasingly important at both national and international policy levels, shaping the conceptual understanding of environmental sustainability in HDRs. The incorporation of valuation methods—particularly contingent valuation, travel cost, and hedonic pricing—sought to put monetary prices on ecosystem services and natural resources, bringing them into cost-benefit analysis employed for environmental policy appraisal (Toman, 1998).

Use of altered economic indicators such as green GDP, net savings, and genuine savings also reflected rising institutionalization of environmental economics in international developmental reporting. These indicators attempted to revise conventional GDP measures by taking into consideration resource depletion and environmental degradation, harmonizing developmental planning with environmental thinking (World Bank, 2006). HDRs at that period discussed such frameworks, particularly with reference to natural capital accounting and sustainable livelihoods.

But otherwise, this model relied upon neoclassical assumptions—chief among them, substitutability between nature and humanmade capital, valuation at the margin, and maximization of efficiency as the only goal. Thus, deeper ecological concerns, such as thresholds that cannot be reinstated, system feedbacks, and value within ecosystems, stayed

excluded (Martinez-Alier et al., 2002). Environmental concerns stayed conceived as separate, measurable problems that could be resolved by optimizing policy instruments, yet not signaling systemic socio-ecological disasters.

Critiques by ecological economists now pinpointed the flaws within market frameworks. They pointed out that valuing nature had the propensity to inaccurately reflect its multi-functional provision, culture, and regenerative potential, and might actually commodify ecosystems without adequately protecting them (Spash, 2008). Ecological economics, however, remained institutionally peripheral within HDRs throughout the 2000s, upholding their penchant for frameworks that could coexist with prevailing growth-based models.

However, this period helped significantly in verifying environmental concerns within the realm of economic policymaking. By conceptualizing environmental destruction as a measurable and controllable economic issue, HDRs helped foreground environmental dilemmas within the realm of developmental discourse, even if the remedies stayed bounded by the epistemological limits of environmental economics.

4.2.3. Phase III: Emergence and Institutional Recognition of Ecological Economics (2010–2015)

It was during the 2010–2015 time frame that the paradigmatic directionality of the *Human Development Reports* (HDRs) underwent a watershed shift, representing a slow but significant movement toward the ideals of ecological economics. This shift was triggered by advancing planetary emergencies, such as deepening climatic change, erosion of biodiversity, and environmental deterioration, that strained the capacities of market-oriented environmental methods to consider systemic peril and ecological thresholds (Rockström et al., 2009). Ecological economics first attained institution-based visibility with HDRs that increasingly included language and thinking recognizing biophysical bounds to human development. In particular, the notion of “planetary boundaries”—pioneered by Rockström and coauthors in 2009—offered a scientifically valid conceptual basis for contem-

plating Earth-system thresholds that cannot be transcended without risking planetary environmental destabilization. This conceptualization put forward the importance of staying within “safe operating spaces” for humankind, and hence directly challenged long-held economic assumptions of indefinite substitutability between nature and man-built capital (Steffen et al., 2015).

2011 HDR (*Sustainability and Equity: A Better Future for All*) embodied such conceptual transformation by proclaiming human development and environmental sustainability fundamentally intertwined. It pioneered the thought that environmental destruction most severely impacts the poorest and most vulnerable, consistent with distributive justice, intergenerational equity, and ethical pluralism that ecological economics promotes (UNDP, 2011). The report additionally began recognizing systemic dependency between ecological and social systems, illuminating how vulnerability due to climate threatens human capabilities and developmental possibilities.

The 2015 HDR (*Work for Human Development*) again followed this pattern, utilizing resilience-based language and conceptualizing economic and environmental challenges in broader integrative terms. While still hesitant in deviating from established economic approaches, the report cited the concept of resilience as the ability of systems to absorb shock and retain essential functions, a notion at the core of ecological economics with foundations in systems theory (Folke, 2006). The report discussed the role of institution-based innovations that put sustainability and long-term well-being above short-term economic benefits.

Despite such developments, ecological economics was only partially incorporated into the institutional discussion within the HDRs. Main pillars such as degrowth, non-substitutability of crucial natural capital, or steady-state economics were yet absent or merely implicitly recognized. Yet, the rhetorical reference to ecological thresholds, planetary limits, and systems’ resilience disclosed an overt shift away from the instrumentalism that prevailed during the previous phase. The phase therefore serves as a transitional phase during which ecological economics first began to impact prevailing development

discourses, paving the way for more radical paradigmatic shifts during the following years.

4.2.4. Phase IV: Hybridization and Ecological Realism under the SDG Framework (2016–Present)

The post-2015 phase, characterized by the SDGs' adoption, is a paradigmatic hybridization across the *Human Development Reports* (HDRs), where ecological economic thinking has increasingly stood out within broader developmental thinking. The post-2015 phase symbolizes a significant movement out of previous environmental economics dominance towards an institution-based new emerging synthesis that selectively incorporates ecological realism. One such watershed moment amidst this transition was the release of the 2020 HDR, *The Next Frontier: Human Development and the Anthropocene*, that officially validated the Anthropocene as a new geological epoch characterized by human induced planetary transformation (UNDP, 2020). In doing so, it was the first HDR ever that confronted planetary dynamics, planetary boundaries, and systemic environmental risk directly. Human development was thought neither simply with reference to capabilities and freedoms, but instead with reference to being, by necessity, circumscribed by biophysical limits—an axis guiding ecological economics (Steffen et al., 2015).

Though such rhetorical shift amounted to important breakthroughs, ambivalence remained the mark of institutional practice. Continued emphasis upon “green growth,” technological optimism, and “inclusive innovation” suggested the lingering influence of neoclassical economic rationality within the domain of development planning. Nevertheless, thinking that is compatible with strong sustainability—such as ecosystem resilience, critical natural capital, and planetary health—became increasingly influential within the discourse at the UN, even if often expressed in the language of risk management rather than structural transformation (UNDP, 2020; Costanza et al., 2016).

Notably, during this phase there were even tentative allusions toward long-held conceptualizations within the literature of degrowth and steady-state economies, even if with-

out explicit endorsement. “Decoupling” growth from environmental destruction and “regenerative economies” showed up with greater frequency in working papers at the UN, suggesting the gradual encroachment of ecological economics into the mainstream institutions (Hickel, 2020). Nevertheless, profound criticisms of the growth imperative, consumption-based economies, and planetary inequalities stayed peripheral within official reports, showing the continuing limits of political and institutional inertias.

However, the hybrid nature of this period should not be downplayed. By positioning development in the Anthropocene frame, the UNDP established conceptual room for the cross-integration of socio-ecological systems thinking, ethical pluralistic approaches, and long-term planetary care—central tenets of ecological economics (Daly & Farley, 2011). Although yet short of representing a complete paradigm shift, the period represents rising institutional recognition of the systemic basis for ecological limits and the imperative for comprehensive and equitable sustainability shifts.

4.3. THEMATIC TRENDS AND PERIODIZATION IN HDR’S: AN ECOLOGICAL AND ENVIRONMENTAL ECONOMICS PERSPECTIVE

1. **Early Market-Centric Sustainability (1990–2000):** Characterized by robust institutional support for market-based solutions, economic appraisal of environmental harm, and incremental adjustments within existing economics paradigms. Environmental economics became central, shaping world sustainability thought with pragmatic, economically compatible methods.
2. **Transition Toward Ecological Integration (2001–2014):** Characterized by rising awareness of environmental limits and the inadequacies of market-based instruments by themselves. Terms like resilience, ecosystem services, and critical natural capital came prominently to the fore, evidencing rising influence by ecological economics, even if mostly within incremental, reform-based approaches.

3. **Emergence of Planetary Realism and Hybridization (2015–Present):** Characterized by overt recognition of planetary boundaries, systemic risks, and the Anthropocene. This phase has witnessed hesitant hybridization between ecological and economic perspectives, showing greater conceptual integration while emphasizing lingering frictions and contestations between transformative systemic transformation and incremental reform.

These thematic waves at the same time mirror fluctuating intellectual trends just as they reveal fluctuating institutional reactions to sustainability issues. They offer valuable understanding of how planetary policy narratives evolve—sometimes incrementally, sometimes more meaningfully—to environmental realities and moral imperatives, as embodied and enunciated within HDRs. Detailed discussion of each wave makes possible sophisticated comprehension of complicated interplay between conceptual paradigms, organizational architecture, and planetary sustainability narratives.

4.3.1. Economic Growth and Sustainability as Compatible Objectives (1990–2000)

The first HDRs appeared against the backdrop of profound optimism at the conclusion of the Cold War, marked by rapid globalization, extensive market liberalization, and institutional optimism regarding the effectiveness of market mechanisms to resolve global problems. In this decade, sustainability was conceived mostly through the neoclassical economics frame, articulated explicitly as a subsidiary goal alongside sustained economic growth and development. Key themes in these first reports included reducing poverty through economic growth, free-market integration, technological progress, and incremental measures toward addressing environmental challenges. Sustainability was conceived mostly as an issue of effective resource allocation, market adjustments, and internalizing environmental .

This market-oriented thematic way reflected closely the environmental economics paradigm that by the early 1990s had gained widespread institution-based support due to compatibility at the conceptual and methodological level with orthodox thinking.

Paradigm-setting theories by neoclassicists such as David Pearce, Robert Solow, and William Nordhaus constituted the underlying conceptual foundations and analytical tools often utilized by HDRs at this juncture. Reports, for instance, often utilized the term “green GDP” and environmental accounting, bearing witness to influence by writings by Pearce concerning modified national accounts and by Solow concerning conceptualizations of sustainability through maintenance of intergenerational stocks of capital. In analogous manner, integrated assessment methods for the case of climate change by Nordhaus with his advocacy for marginal cost-benefit analysis and market-oriented methods for mitigation found powerful reflections among HDRs.

The sustainability narrative developed through HDRs from this generation was optimistically presumptive regarding the potential for technological breakthroughs, economic benefits, and proper functioning of markets to control environmental impacts efficiently. Environmental issues, from pollution and resource depletion to biodiversity erosion and climate change, were overwhelmingly viewed as controllable “externalities”—the unwanted economic activity’s negative side-effects that could be addressed with focused economic instruments such as pollution levies, tradeable emissions permits, and rule-based regimes that are consonant with sound cost-benefit analysis. The assumption behind such frameworks was that proper valuation and pricing regimes could internalize environmental harm and reward sustainability without severely inhibiting economic growth or basic consumption profiles. Additionally, organizational environments for principal world institutions, notably the World Bank, International Monetary Fund (IMF), and Organisation for Economic Co-operation and Development (OECD), solidified such framing by prioritizing economic efficiency, privatization, deregulation, and free markets as principal pillars for global development and poverty reduction approaches. The HDRs mirrored such perceptions by prioritizing poverty reduction through economic growth as a principal force for enhancing human capabilities and general well-being and, consequently, implicitly agreeing that growth was an inevitable condition for achieving human development objectives.

However, this market-favored approach to sustainability contained serious deficiencies. Most importantly, it showed minimal attention or low priority toward ecological eco-

nomics' pioneering warnings regarding biophysical limits, irreversible devastation of ecological systems, and dangers of systemic disintegration from reckless economic growth. Concepts such as entropy, resilience, carrying capacity, and strong sustainability—promulgated and pioneered by ecological economists such as Herman Daly, Nicholas Georgescu-Roegen, and Kenneth Boulding—were notably absent from these earliest HDRs. This absence revealed institutional leanings for economic efficiency, substitutability of natural capital, and incremental adjustments rather than transformative measures toward ecological constraints.

Overall, the thematic decade 1990–2000 in HDRs framed economic growth and environmental sustainability as mutually compatible goals achievable by increasing market efficiency and technological innovation. This first institutional consistency with environmental economics had much impact upon the international discussion concerning sustainability, focusing upon incremental adjustments rather than transformative changes. Nevertheless, this narrative excluded at a deeper ecological level, paving the way for critical reactions and paradigm changes during the following time periods.

4.3.2. Recognition of Ecological Limits and Emergence of Human-Ecological Interdependencies (2001–2014)

It was during the early 2000s that the world experienced an important watershed moment with respect to sustainability discussion, one that involved the increasing serious recognition of the delicate interdependencies between human development and ecological systems. In contrast with the previous decade, during which sustainability was mostly discussed within market-based, growth-compatible paradigms, the reports of *Human Development Reports* (HDRs) during this time frame increasingly took serious notice of ecological limits and their immediate consequences for human welfare. Main themes began gradually to move away from incremental market responses toward an appreciation for human and ecological well-being as an intertwined unit that cannot be separated, focusing more on ecological limits, ecosystem health, biodiversity conservation, and the wider ecological bases for social and economic progress.

One such milestone in this thematic development was the 2007/2008 HDR, *Fighting Climate Change: Human Solidarity in a Divided World*, which notably framed climate change not only as an environmental externality, but as a critical systemic threat to human development at the global level. This report evidenced increasing institutional awareness of ecological interdependencies, highlighting environmental crisis disproportionate impacts on poor and vulnerable groups and emphasizing moral responsibilities for global co-operation, intergenerational equity, and distributive justice. Importantly, this HDR spoke with language consistent with ecological economic critiques, referring critically to the insufficiency of conventional measures, such as GDP, to represent actual human well-being and ecological sustainability. It encouraged comprehensive, systemic approaches to governance for climate, drawing together scientific knowledge with equitable policy measures.

Capitalizing on this momentum, the 2011 HDR, with the explicit title *Sustainability and Equity: A Better Future for All*, again emphasized this paradigm shift. For the first time, the report thoroughly connected sustainability with equity by name, and stressed how environmental destruction disproportionately weakened developmental possibilities of the planet's poorest and most excluded populations. In the process, it directly incorporated principal tenets enjoining ecological economists—such as resilience thinking, intergenerational justice, and ecosystem critical thresholds—within their human development frame. The recognition by the report of ecological limits and the necessity for preserving important ecosystem functions for the assurance of equitable human development marked a profound shift from previous stories that took comprehensive substitutability between natural and manufactured capital for granted. The rising thematic affinity with ecological economics at this time mirrors explicit and implicit intellectual influences from seminal figures such as Herman Daly, Robert Costanza, Joan Martinez-Alier, and Johan Rockström. Daly's emphasis on strong sustainability—non-substitutability of critical natural capital and stable biophysical throughput—started gaining traction within HDR stories, albeit gradually and step-wise. Costanza's seminal writings, especially valuation of ecosystem services and prioritization of ecological integrity, mirrored the emerging recognition within HDRs that ecosystems yield irreplaceable support systems that are critical

to sustaining human life. In the same manner, Martinez-Alier's conceptualizations of environmental justice and ecological distribution conflicts saw partial expression with the HDR's recognition of inequitable effects and differential responsibilities with respect to ecological deterioration. Rockström's pioneering presentation of planetary boundaries, venturing forth with explicit identification of thresholds of critical Earth system processes, lent additional scientific legitimacy and institutional recognition of ecological limits by these reports.

Despite such groundbreaking thematic advances, the period was characterized by institutional caution. HDR narratives embraced ecological realism and highlighted systemic interlinkages between human and ecological systems, yet again held back from fully embracing transformative potential. The existing global development institutional arrangements—inferred from economic growth, market expansion, technological changes, and incremental reform at the governance level—remained fundamentally intact. HDR narratives consequently took the shape of a hybrid format, incorporating ecological-economic criticism and thinking without fully abandoning prevailing market-based approaches toward development.

Overall, the thematic phase spanning 2001-2014 was a watershed phase in the unfolding of global sustainability discourse. Identification by institutions with ecological limits and human-ecological interdependencies marked an important, yet circumspect, shift toward the essential premises of ecological economics. Inasmuch as ecological thresholds, resilience, intergenerational justice, and equity increasingly became salient focal points within HDR narratives, entrenched confrontations with economic growth and orthodox development paradigms tempered the amount of transformative change called for by ecological economists. Nevertheless, the phase gave important conceptual and discursive foundations, paving the way for increased incorporation of ecological realism in subsequent global sustainability narratives.

4.3.3. Anthropocene, Planetary Boundaries, and Systemic Sustainability (2015–Present)

Since around 2015, thematic stories in the *Human Development Reports (HDRs)* have increasingly included an explicit and nuanced interaction with ideas at the heart of ecological economics, most notably the Anthropocene, planetary boundaries, resilience thinking, and systemic sustainability. This new shift corresponds closely with the arrival at widespread global scientific consensus that points to humanity's record and potentially irreversible influence upon the ecological and geological systems of Earth. HDRs from this most recent time frame frame sustainability by reference to systemic ecological changes most forcefully yet between the prevailing global policy discussion and central ecological economic viewpoints. Its seminal thematic moment was the historic 2020 HDR, *The Next Frontier: Human Development and the Anthropocene*, which forthrightly placed human development within the larger Anthropocene frame—the recently suggested geological age defined by widespread and enduring human alterations to the natural systems of the planet. This thematic emphasis highlighted the interlinkage between ecological soundness and human well-being and confronted directly the harsh realities of climate change, biodiversity erosion, acidification of the oceans, and deforestation, which individually and together jeopardize the very conditions of human survival. By bringing the Anthropocene construct into HDR narratives, HDRs willingly agreed that prevailing models of development—based on endless economic expansion and extraction of resources—stand seriously at odds with the reality of ecological thresholds and tipping points.

At the center of this new thematic emphasis has been the deliberate incorporation of the notion of planetary boundaries first proposed by Rockström and coauthors in 2009 and then updated by Steffen et al. This conceptual structure identifies planetary biophysical systems' critical thresholds, beyond which abrupt and irreversible environmental shifts might take place. HDRs spanning this time frame have increasingly employed planetary boundary terminology, deliberately calling out thresholds connected with climate stability, availability of freshwater, integrity of biodiversity, and biochemical fluxes, stressing that such transgressions represent an existential risk at many scales for human societies

everywhere. Such discourse is commensurate with ecological economics' own focus on biophysical realism and non-substitutability, deliberately recognizing that some ecological procedures and functions cannot be simply substituted away by technological advance or by economic substitution.

Another idea significantly incorporated into new HDR stories is resilience thinking, initially designed by researchers like C.S. Holling, Carl Folke, and Brian Walker. Resilience stresses the ability of socio-ecological systems to absorb disturbances, adapt, and reorganize without passing critical thresholds into unwanted system states. In new HDRs, resilience now shows up not just as a metaphor but as an organizing principle for policy action and development planning. Reports increasingly recommend constructing adaptive capacities, lowering vulnerabilities, and creating systemic elasticity to resist ecological shocks, like climate-associated disasters or pandemics—ideas with deep roots in ecological economics' systemic thinking about socio-ecological interactions.

Additionally, new HDRs have adopted and adapted the principle of strong sustainability, most prominently articulated by Herman Daly, Eric Neumayer, and others. Strong sustainability's maxim that crucial natural capital cannot be replaced and important ecosystem functions must be maintained intact has shaped HDRs' discussions concerning ecological accounting and indicators of sustainable development. One empirical illustration of such incorporation is the formulation of the Planetary Pressures–Adjusted Human Development Index (PHDI) for the 2020 HDR. The PHDI incorporates ecological footprints—emissions of carbon and extraction of materials—as explicit elements of the traditional Human Development Index, constituting a conclusive step toward consideration of ecological limits within established institutionally agreed measures of human progress.

In spite of such explicit thematic convergences with ecological economics, HDR reports during this phase are still marred by significant conceptual strains. Institutional momentum and deep-seated ideological predispositions toward economic growth, market-based fixes, and technological utopianism dampen the transformative character of ecological realism. Ecological ideas are ever more mainstreamed, yet policy prescriptions tend to stress

incremental fine-tuning, innovation-based green growth, and incremental decoupling of economic growth from environmental impact instead of embracing deeper systemic shifts prioritized by ecological economists like degrowth, steady-state economics, or epistemological changes in consumption and production models.

Therefore, the new thematic emphasis among HDRs (2015–present) represents both significant conceptual developments and continuing institutional reservations. The explicit embrace of Anthropocene framing, planetary boundary thinking, resilience thinking, and robust sustainability measures represents an important step forward for global sustainability thinking. Nevertheless, the transformative potential of ecological economics is kept in check by institutional circumspection and political practicality, testifying to continuing tensions between accepting radical ecological critiques and sustaining prevailing economic thinking. Nevertheless, this phase represents, unequivocally, the most explicit and consistent institutional recognition of ecological economics' central insights, providing essential groundwork both for possible greater future paradigmatic incorporation and systemic policy changes.

CONCLUSION

This thesis is aimed at analyzing how the two prevailing paradigms in environmental thinking, environmental economics and ecological economics, have influenced intellectual and policy discussion on sustainability and development. Although both paradigms arose out of reactions to failures of orthodox economics, especially amid rising ecological emergencies, they diverge significantly with respect to their underlying assumptions, approaches, and normative engagement. Environmental economics applies neoclassical economic instruments for addressing environmental problems, focusing on market-based tools, economic valuation of externalities, and cost-benefit analysis. Ecological economics, on the contrary, confronts head-on the growth-oriented paradigm, integrating economic analysis with the conditions of thermodynamic limits, moral pluralism, and systemic biophysical limits.

Chief among the motivations for this study was answering an important question: which between these two paradigms has greatly shaped global conceptualizations employed to define, quantify, and advance human development, particularly within the influential United Nations Development Programme's (UNDP) *Human Development Reports (HDRs)*. In an organized manner, addressing this involves the utilization of reverse reversing methodology and conceptualizing key-words, with data sourced from the Web of Science databases, and a systematic content analysis of HDRs released between 1990 and the current date.

Analysis identifies distinct patterns of conceptual and institutional influence over time. First, environmental economics, given its compatibility with mainstream economic institutions in their methodological approach, showed universal institutional uptake. Early HDRs officially incorporated environmental economics-based conceptualizations and instruments, such as monetization of externalities, modified measures of economic per-

formance (e.g., “green GDP”), and market-based environmental approaches. The pragmatic incorporation provided a smooth fit with prevailing growth-based development approaches, facilitating rapid and universal adoption among powerful institutions, especially the World Bank, IMF, and OECD.

However, the findings also indicate that ecological economics, despite its relatively marginal institutional position, has gradually but significantly influenced global policy discourse, especially since the early 2000s. Key ecological economic concepts such as planetary boundaries, resilience, strong sustainability, and the Anthropocene have progressively permeated HDRs, becoming notably prominent in recent editions post-2010. Yet, this influence has often occurred at the rhetorical rather than structural level: ecological terms and frameworks are now frequently acknowledged but typically in ways that do not fundamentally challenge entrenched commitments to economic growth, market-based mechanisms, and technological optimism. In other words, ecological economics has been selectively absorbed into institutional vocabularies without fully penetrating or transforming underlying economic structures.

This selective receptiveness toward ecological economics is part of a larger and recurring pattern in global sustainability governance: transformative ecological thought is embraced theoretically and verbally but opposed at deeper structural and practical registers. Such opposition betrays the extensive institutional rigidity and political nuance that accompanies truly reframing economic policy and developmental architecture toward ecological realism, moral pluralism, and systemic resilience.

Thus, the thesis concludes that ecological economics, despite minimal direct institutional representation, has nevertheless afforded fundamentally seminal conceptual visions and criticisms that have increasingly framed prevailing visions of sustainable development. Its thought has attained irrefutable momentum with respect to shaping the ways by which sustainability challenges are conceptualized, assessed, and discussed across the globe, but significantly, not yet how policy is substantially designed and implemented. This selective, partial adoption betrays significant barriers that remain inhibiting the translation

of ecological realism into transformative institutional practice.

The consequences of these results reach well beyond the academy, directly impacting policy and practical governance for sustainability. For researchers, the study points up the essential importance of serious work with rival paradigms. For politicians, the study makes clear the importance of moving beyond shallow deployments of ecological language toward greater incorporation of ecological constraint, moral imagination, and distributive justice within concretely realized development policy and practice.

Lastly, if sustainability is ever going to move out of the sphere of rhetoric and get inscribed into important global practices, intellectual bases of ecological economics must be given their due consideration. Sustainability at last hinges upon institutional and structural adjustments that are founded neither merely upon discourse nor merely upon hard measures, policy instruments, deployment of resources, and long-term planning for expansion. Global governance must truly redefine itself upon the contours of ecological realism, systemic thinking, and ethical pluralism that have been articulated by ecological economics, not merely upon paper, but upon hard realities of measures, finances, and infrastructures.

It therefore advocates for renewed intellectual and organizational interest in ecological economics, that its critical acumen and original thinking are incorporated more fully and sincerely by planetary sustainability governance. It is only with such transformative incorporation that sustainable human development becomes something more than an intellectual aspiration instead an empirical reality shaping human societies' future within planetary bounds.

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