Holistic Ethical Assessment of Industrial Ecology Research

Mapping and Systematically Scrutinising Moral Assumptions
for Informed Scientific Decision Making

A thesis submitted for the master's degree of

Industrial Ecology

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July 2025

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HoME Profile *

Scientific Contribution

I explored how researchers working on sustainability-related topics think about what is right or wrong in their work, and designed a tool to help people better understand, reflect on, and communicate the reasoning behind these decisions.

Core Recommendation

I recommend that every paper discussing sustainability includes a short profile that summarises what it adds to science, what action it recommends, the underlying assumptions that justify such action, and what would likely happen to everyone affected if that action were carried out.

Underlying Assumptions

In sustainability research, I assume that people can be supported in judging what is right or wrong by revealing how its recommendations would affect the lived experience of all the people and animals involved.

Affected Groups   ## Experiential Impacts

Affected Groups	Experiential Impacts
Sustainability researchers and educators	Would understand, explain, and teach the meaning of their work more clearly, and reflect more explicitly on its moral foundations and real-world effects.
Policymakers	Would have a better overview of sustainability research and make decisions with greater awareness of both its moral foundations and who will be affected and how.
Journalists/science communicators	Would have a more complete picture of sustainability research, better recognise its moral basis, and more easily share its findings, recommendations, and impacts.
The general public	Would have a clearer understanding of sustainability research, see how it determines what is considered right and wrong, and feel more able to take part in public conversations and make informed choices.
Any person or animal affected by sustainability decision making	Would benefit from more thoughtful and effective sustainability decisions, as people take their lived experiences more seriously.

* The Holistic Moral Evaluation (HoME) Profile is an overview that clarifies the core message and potential impact of sustainability research, makes its moral assumptions explicit, and helps communicate its findings more clearly to a broader audience.

Statement on the use of Artificial Intelligence (AI)

For this thesis research project, AI has been used to identify and interpret relevant papers and grey literature and provide suggestions for improving the clarity and writing quality of the report. All factual information provided by AI has been independently verified.

EXECUTIVE SUMMARY

Although Industrial Ecology (IE) aims to optimise resource use, reduce environmental impacts, and promote sustainable systems, many of its methods and proposed solutions rely on normative decisions that often remain implicit. This thesis explores the foundational role of ethics in IE by examining how explicit and implicit moral assumptions influence its research and applications. Drawing on examples such as the Circular Economy, green growth and degrowth, Life Cycle Assessment, and anthropogenic impacts on nonhuman animals, this research shows how unresolved ethical tensions can shape both the direction and effectiveness of IE and sustainability research more broadly. In response, this study develops a systematic tool to help researchers identify, evaluate, and communicate the moral assumptions underpinning their work.

To explore how ethics is explicitly applied, a targeted literature review of 32 IE-related papers was conducted. Each paper was assessed for its use of ethical theories, its moral assumptions, and the role these play in guiding research outcomes. While a wide variety of ethical theories are referenced in the literature, no single one dominates the field. Nonetheless, outcome-based reasoning, focused on how people or animals would be affected, is consistently used to justify normative choices. The analysed papers also pay special attention to the perspectives of underrepresented groups, such as informal workers, nonhuman animals, and future generations.

To analyse implicit ethical views, two case studies covering 53 papers were conducted: one on green growth versus degrowth, and one on anthropogenic impacts on nonhuman animals. The results suggest that moral disagreements are often rooted in differences in reasoning and available information, rather than in fundamentally opposing and irreconcilable views. Across both case studies, normative arguments again tended to rely on the anticipated impacts on affected groups, reinforcing earlier findings. These results were presented in a Delphi study with a panel of academic experts, who discussed them from multiple perspectives. Despite some differences in interpretation, participants broadly supported the need for moral pluralism, transparency, and experience-based ethical reasoning, while cautioning against rigid, prescriptive frameworks.

Building on these insights, this thesis proposes a non-prescriptive framework for evaluating moral assumptions in sustainability research: the Descriptive Holistic Moral Framework (DHMF). Grounded in four key premises that emerged from this research, the DHMF centres on the lived experiences of all sentient beings affected by sustainability-related decisions. It forms the foundation for the Holistic Moral Evaluation (HoME) Profile, which is a one-page overview designed to help researchers summarise their scientific contribution, core recommendation, moral assumptions, and anticipated experiential impacts. By making ethical reasoning more visible and accessible, the HoME Profile supports clearer communication, critical reflection, and broader engagement with stakeholders, even those without a scientific background.

Ultimately, this thesis argues that ethical reflection must become a core part of sustainability research. The DHMF and HoME Profile do not replace existing ethical theories but complement them by promoting transparency, inclusivity, and shared responsibility in addressing the urgent and complex sustainability challenges of the 21st century.

CONTENTS

GLOSSARY

This research adopts a holistic perspective to examine the philosophical foundations of Industrial Ecology. In order to build a transparent framework and prevent misunderstandings, all terms with potentially ambiguous interpretations are carefully defined. Accordingly, this glossary provides detailed definitions to provide clarity on how each of these terms will be used in this research.

General

Ethical theory: A specific philosophical approach to understanding and evaluating morality, which includes theories such as virtue ethics, deontology, and utilitarianism.

Ethics: The systematic study of morality, using theories, methodologies, and structured approaches to evaluate, guide, and justify moral decision making.

Experiential information: Information about who is affected by a decision, how they are affected, and for how long.

Holistic: Referring to an all-encompassing, non-prescriptive, and impartial viewpoint that arises between all individuals, both human and nonhuman, rather than from any single perspective.

Industrial Ecology (IE): The interdisciplinary study of systemic interactions between human and natural systems, focused on optimising the flow of energy and materials, minimising environmental impacts, and promoting sustainable systems.

Interpersonal: Taking into account the perspectives and interests of all people equally, without privileging one individual over another without justification.

Interspecies: Taking into account the perspectives and interests of all animal species equally, without privileging one over another without justification.

Morality: A set of standards, principles, or values that define right and wrong behaviour.

Moral framework: A broad and structured system that guides moral decision making, including both ethical theories as well as applied approaches such as Corporate Social Responsibility (CSR) and Responsible Research and Innovation (RRI).

Sentient being: Any organism or entity that has subjective experiences.

Sustainability: A concept that acts as a modifier, referring to the capacity for continuity through time within a specific context (e.g., sustainable environments or sustainable agriculture), while inherently reflecting underlying values about what is worth sustaining. (Shearman, 1990)

Types of ethics

Applied ethics: Any branch of ethics, whether principle-based or outcome-based, that focuses on specific fields or practical contexts (e.g., relational, environmental, or business).

Distributional ethics: A category of applied ethical theories concerned with the moral allocation of benefits and burdens, which includes theories such as egalitarianism, prioritarianism, and sufficientarianism.

Environmental ethics: A category of applied ethical theories concerned with human relationships with the nonhuman environment, which includes theories such as biocentrism, ecocentrism, and deep ecology.

Outcome-based ethics: Any ethical theory that judges the morality of a decision based on its consequences.

Principle-based ethics: Any ethical theory that judges the morality of a decision based on universal moral principles, such as values, rights, virtues, rules, contracts, or duties.

Types of disagreements

Fundamentally irreconcilable disagreement: An insurmountable conflict in decision making that arises despite access to similar information and the application of comparable reasoning, due to diverging moral views on what goals are ultimately desirable.

Information-based disagreement: A conflict in decision making that arises primarily from differences in the availability or completeness of knowledge.

Reasoning-based disagreement: A conflict in decision making that arises primarily from differences in how information is interpreted, often stemming from methodological differences.

ABBREVIATIONS

CE: Circular Economy

CSR: Corporate Social Responsibility

DHMF: Descriptive Holistic Moral Framework

EEIOA: Environmentally Extended Input-Output Analysis

HoME: Holistic Moral Evaluation

IE: Industrial Ecology

LCA: Life Cycle Assessment

MFA: Material Flow Analysis

RRI: Responsible Research and Innovation

SCM: Supply Chain Management

SDGs: Sustainable Development Goals

1. INTRODUCTION

1.1 General Background

In early 2012, the United Nations Environment Programme (UNEP) published a report titled *21 Issues for the 21st Century*, presenting a ranked overview of the emerging environmental issues humanity would have to face in the coming century. Among the most critical were moving towards a green economy, integrating biodiversity across environmental and economic agendas, and, most important of all, aligning governance to the challenges of global sustainability. (UNEP, 2012)

In 2015, all United Nations member states also adopted 'a shared blueprint for peace and prosperity for people and the planet' (United Nations, n.d.) in the form of the now well-known Sustainable Development Goals (SDGs). These also included a focus on sustainable industry and communities, as well as responsible consumption and production. The final SDG once again underscores the need for global partnership for sustainable development.

Consequently, these challenges of sustainability require not just an interdisciplinary approach, but also a focus on the relationship between human and natural systems. Industrial Ecology (IE) fits this role, focusing on optimising resource use (e.g., through material and energy efficiency), minimising environmental impacts (e.g., by reducing waste and emissions), and promoting sustainable systems (e.g., by advancing the Circular Economy) (International Society for Industrial Ecology, n.d.).

However, despite IE's holistic approach, an important question remains: what does sustainability truly entail and what is it ultimately trying to achieve? Shearman (1990) addresses this issue and argues that "*[…] if we wish to achieve some sort of consensus on environmental or development policy that is ecologically sustainable, then we should be prepared to tackle, at least in general, such questions as: Why is sustainability desirable? What form of sustainability is best? With what means should we seek to achieve sustainability? These questions are necessary because sustainability is more than an issue in managing our environment; it is also an issue in managing ourselves*".

In other words, at the core of these global challenges and the role that IE research might play are questions about humanity's underlying objectives and the possible right and wrong ways to achieve them. As a result, ethics must play a foundational role in guiding this research. However, there are many different ethical theories that allow us to do this, each with a different focus, and there does not seem to be a consensus on which to use. They can be broadly categorised as outcome-based (consequentialist) or principle-based (non-consequentialist), although not all theories neatly fall into one of these categories (i.e., hybrid ethical theories).

When it comes to our industrial systems and all those whose well-being and health are impacted by them, some form of normative claims must be made, and yet this threatens the neutrality of the scientific method itself. As a result, transparency about the application of ethical theories and their associated objectives is of vital importance (Alexandrova, 2018). Without such transparency, scientifically rigorous research may unintentionally support conflicting policies due to incompatible underlying assumptions. This divergence, on top of the already conflicting political and economic interests, adds yet another layer of complexity to the already substantial challenges facing humanity this century.

1.2 Specific Background

1.2.1 Literature Overview

IE encompasses a diverse range of fields of study, including the Circular Economy (CE), sustainable Supply Chain Management (SCM), and industrial and urban metabolism. Researchers also use various tools in these fields, such as Life Cycle Assessment (LCA), Material Flow Analysis (MFA), and Environmentally Extended Input-Output Analysis (EEIOA), each of which is aimed at optimising resource use, minimising environmental impacts, and promoting sustainable systems. However, these fields and tools are still subject to important unresolved ethical debates. In order to demonstrate this, it is useful to examine a few examples.

Hidden ethical tensions in IE

Firstly, research into the CE, a concept central in the transition towards a sustainable economic system, reveals notable ethical concerns. While the CE aims to close material loops and minimise waste, its current implementation may perpetuate social inequities, whether intentionally or not. After all, even the unintentional omission of such issues constitutes a moral decision.

Issues related to human development objectives like human rights, international justice, equality, and poverty are mostly neglected by the existing CE narrative. For example, the general employment of workers in low- and middle-income countries can be disproportionately affected by closed-loop supply chains. In addition, the health and well-being of workers in the informal sector (i.e., not formally regulated by the state) are often not properly addressed by CE initiatives. (Schröder et al., 2020)

Similar concerns arise when examining the related concepts of green growth and degrowth. Starting with green growth, we find that the concept itself may be based on a misguided objective. Despite widespread support in national and international policy, there is little empirical evidence to suggest that resource use can be effectively decoupled from economic growth (Hickel & Kallis, 2020). As a result, well-intentioned and aspirational goals could ultimately undermine equity, transparency, and our shared responsibility to build sustainable systems for the long term.

Degrowth, on the other hand, raises its own ethical and practical challenges. Van den Bergh (2011) criticises it for its ambiguous definition, its lack of alignment with effective environmental strategies, and its limited potential to gain the social and political support necessary for the transition to a sustainable economy and reduction of environmental pressures. This further illustrates that neglecting such ethical and practical concerns, even unintentionally, reflects an important moral choice that must be made explicit.

Similarly, even technical tools like LCA, designed to assess the environmental and social impacts of specific products and support decision making in IE, are not free from ethical tensions and require careful examination.

As Freidberg (2018) highlights, LCA practitioners often have to navigate a tension between maintaining scientific independence and meeting clients' demands for clear-cut and marketable results. As companies become more familiar with LCA, unrealistic expectations have become less frequent, but this conflict remains a persistent concern. Freidberg also notes that while LCA standards aim to minimise the influence of practitioners' values to

maintain objectivity, value judgements are often unavoidable and essential to prevent bias and ensure balanced assessments. For instance, such judgements include decisions about which environmental impacts to prioritise or how to assess trade-offs between different stages of a product's lifecycle. This demonstrates that even in widely applied tools like LCA, ethical conflicts surrounding values and objectivity remain topics of debate. It is therefore essential that these normative dimensions are acknowledged and critically discussed within the practice of such tools.

Another example that is not often directly addressed but is instead intertwined with many IE research areas, is the anthropogenic impacts on nonhuman animals. As Rawles (2006) explains, animal welfare concerns pertaining all sentient beings are often neglected when the goals of sustainable development are only centred around the three pillars of (1) economic development, (2) social justice, and (3) environmental protection. Even though it may look like the latter category covers this, it tends to be concerned with ecological collectives rather than individual sentient animals. Rawles further notes that including the welfare of nonhuman animals in the environmental agenda is sometimes met with resistance, being dismissed as sentimental or suspect.

The role of ethical theories

As all these examples emphasise, there is a clear need for IE to critically engage with the ethical dimensions of its proposed methods and solutions. In order to confront ethical challenges such as these, a wide range of ethical theories have been developed throughout human history. Traditional theories include *principle-based ethics*, which emphasises adherence to certain values, rights, virtues, rules, contracts, or duties, and *outcome-based ethics*, which focuses on the consequences of actions. More recent theories, most of which could be categorised as applied ethics, seek to address ethical issues within specific fields or contexts (e.g., relational, environmental, or business). In Table 1, an overview of the main ethical theories and frameworks is provided.

Table 1: Overview of the main ethical theories and frameworks relevant to IE.

Category	Theory/Framework	Description	Potential relevance for IE
Principle-based	Deontology (duty-based)	Focuses on determining the morality of actions based on adherence to rules, duties, or rights (Schroth, 2019).	Can guide IE practices by emphasising environmental and social duties, such as justice, fairness, and responsibility for future generations.
	Virtue ethics (character-based)	Focuses on the development of character traits (virtues) and is rooted in Aristotle's ideas about human flourishing, knowledge, and the role of virtues in guiding ethical behaviour (M. Winter, 2012).	Can encourage the cultivation of virtues like stewardship, resilience, and moderation to promote sustainable decision making.
Outcome-based	Utilitarianism	Focuses on actions and policies aimed at maximising total well-being, considering a range of interpretations of well-being (e.g., consequentialism, personal good, additivity, and hedonism) (Broome, 2002).	Can promote actions, policies, and goals that increase overall environmental and social well-being.

Category	Theory/Framework	Description	Potential relevance for IE
Applied ethics (non-anthropocentric)	Environmental ethics	Focuses on human relationships with the nonhuman environment, emphasising the recognition of the moral status of individual living things (e.g., biocentrism) and ecological collectives (e.g., ecocentrism) (Palmer et al., 2014).	Can encourage non-anthropocentric decision making by recognising the intrinsic value of ecosystems and biodiversity.
Applied ethics (relationship-focused)	Care ethics	Focuses on relationships, the significance of care practices, and the fulfilment of responsibilities based on attachment (Hamington & FitzGerald, 2022).	Can highlight relational values such as care and interdependence to encourage inclusive practices and equitable stakeholder engagement.
Applied ethics (research-focused)	Responsible Research and Innovation framework (RRI)	Focuses on fostering inclusive and sustainable research and innovation that aligns with societal values, needs, and expectations (Owen & Pansera, 2019).	Can promote inclusive and anticipatory practices in IE research, ensuring outcomes that address societal and environmental needs.
Applied ethics (business-focused)	Corporate Social Responsibility framework (CSR)	Focuses on establishing principles for socially responsible action, using stakeholder analysis and engagement to determine the specific corporate activities that align with these principles (Moir, 2001).	Can enhance the social and ethical impact of industrial practices, encouraging transparency and accountability.

RRI and CSR are no traditional ethical theories and form a distinct category, sharing a collective, practice-oriented focus, and are designed to guide decision making within specific institutional contexts. Unlike ethical theories, they incorporate overarching moral assumptions that reflect the values of their respective domains. Papers applying the CSR and RRI frameworks rarely engage with ethics directly either; instead, they assume the ethical integrity of these frameworks themselves, seldom discussing or questioning their foundational assumptions. While analysing these assumptions is an important task, it falls outside the scope of this research.

1.2.2 Research Gap

As the literature overview has shown, ethical debates in IE research areas are far from resolved, and there are a wide range of ethical theories available to address them. Each of the theories listed in Table 1 make moral claims about right and wrong approaches in these areas, and many also overlap, interact, and reinforce each other. Nevertheless, important differences remain, where they diverge and recommend conflicting courses of action.

Perhaps an even more pressing challenge, however, is that moral assumptions stemming from these theories are often implicit, subtly guiding decision making in research projects while unintentionally steering them towards incompatible goals. These assumptions may even be selectively applied by researchers to support preexisting intentions.

Despite the fundamental role of ethics in sustainability, many IE-related papers, including those discussed in the literature overview, mention ethics or morality only briefly, if at all. But the fundamental discussion of right and wrong cannot be merely an afterthought. In the absence of any clear evaluative ground, research into sustainable industrial systems may risk becoming fragmented and less effective in addressing humanity's most pressing challenges.

This highlights the need for researchers and other stakeholders to critically evaluate research outcomes, policy recommendations, and the moral assumptions that underpin them. Enhancing transparency and consistency in this process would promote greater integrity, ultimately supporting more robust and scientifically responsible decision making across research, policy, and industry.

1.3 Objectives and Research Questions

This thesis research project addresses the identified research gap by taking an initial step towards developing an impartial, interpersonal, and interspecies framework that could provide a shared evaluative basis for IE research across all stakeholder groups. By adopting a holistic, bottom-up approach, this project first maps the moral assumptions underpinning current IE research. It then critically examines these assumptions to lay the groundwork for a tool that allows sustainability researchers to scrutinise them and to support more ethically grounded decision making.

However, for any such tool to be seen as authoritative in helping to evaluate claims about what is right and wrong, it must first withstand the most rigorous scrutiny itself. After all, such a tool cannot itself be subject to the very biases it is meant to uncover. Meeting this challenge is the core ambition of this thesis. Given this objective, this thesis research project aims to answer the following research question:

"How do ethical theories influence Industrial Ecology research and how can their underlying moral assumptions be scrutinised more systematically?"

In order to guide the project, the central research question is broken down into the following sub-questions:

1. How are ethical theories explicitly incorporated into Industrial Ecology-related research?
2. What implicit moral assumptions influence research on green growth/degrowth and the anthropogenic impacts on nonhuman animals?
3. How do these moral assumptions shape the objectives and recommendations in these research areas?
4. What tool can be developed to help assess the moral assumptions in Industrial Ecology research more systematically?

2. METHODOLOGY

This research project can broadly be divided into three phases. Phase 1 addresses the first sub-question, Phase 2 the second and third sub-questions, and Phase 3 focusses on the fourth sub-question. Figure 1 presents a research flow diagram outlining the entire project, including the activities, data requirements, and outputs for each phase.
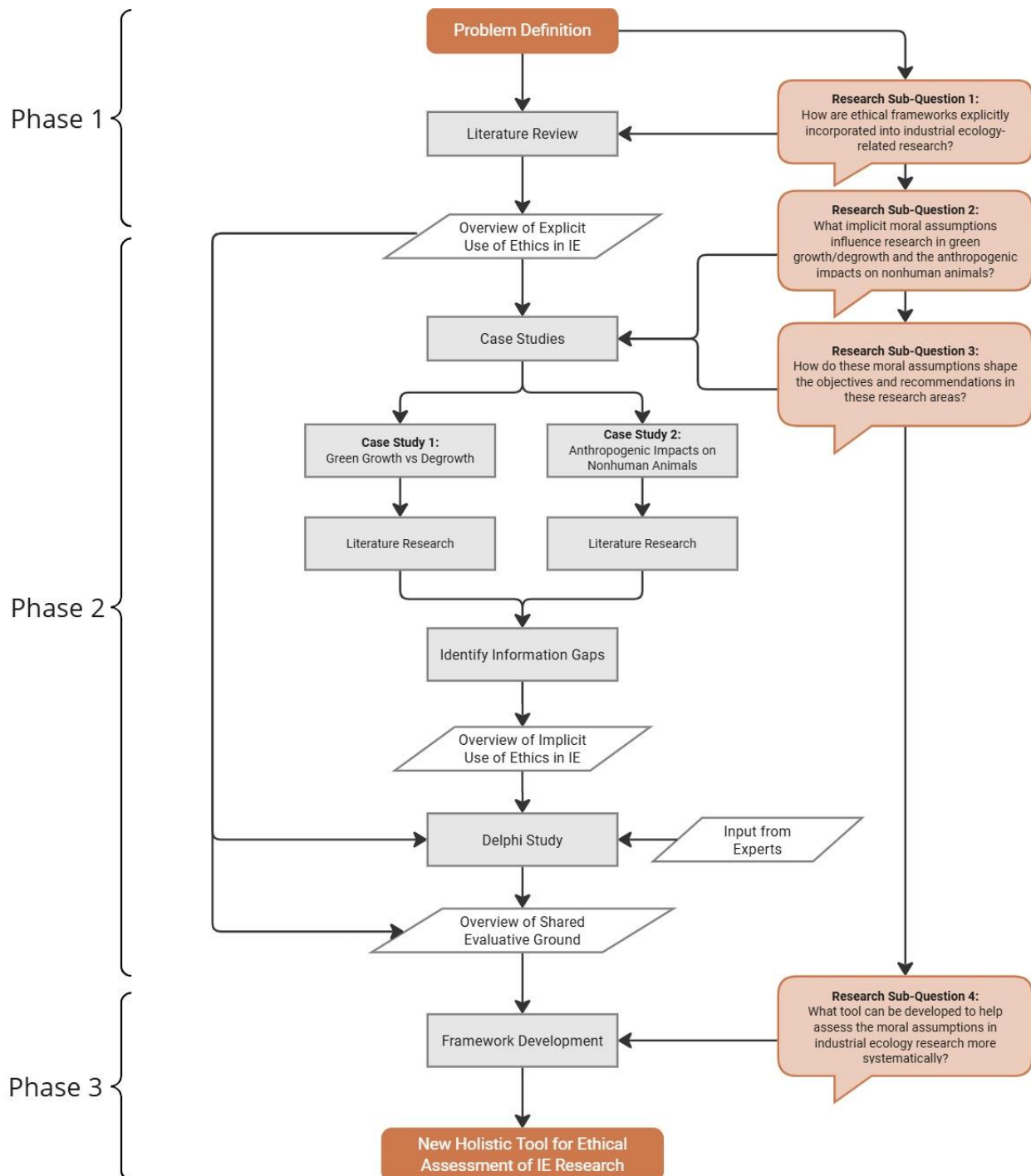

Figure 1: The research flow diagram of the project.

2.1 Literature Review

To build a comprehensive picture of how ethics is currently explicitly applied in IE research, the first phase consists of a targeted literature review. I organised the relevant literature into three groups:

1. Papers explicitly focused on the field of IE itself.
2. Papers from IE-related fields.
3. Papers applying tools commonly used in IE.

As noted in the previous chapter, I deliberately set aside papers applying the CSR and RRI frameworks, since they seldom directly confront ethical issues. To gather relevant publications, I combined ethics-related and IE-related search terms in searches of Google Scholar and the TU Delft Library catalogue. Tables 2 and 3 list the specific search terms related to IE and ethics, respectively.

Although I tested numerous search term combinations, only a small subset produced significant results. I only included papers that were written in English and available to me online. Beyond that, no other restrictions were imposed, as I wanted to capture a broad spectrum of paper types and ethical perspectives. In total, I analysed 32 papers.

For each paper, the following aspects were identified: (1) the ethical theory or theories that were discussed, (2) the main moral assumptions that were made, and (3) the impact these assumptions had on the outcomes and recommendations of the paper. To make this process more efficient, I consulted the generative AI chatbot ChatGPT using the prompt shown in Appendix A. I independently verified all AI-generated information within the papers themselves.

Table 2: Overview of the IE-related search terms used to identify papers explicitly discussing ethics.

Category	Search Term
General	Industrial Ecology
IE-related fields	Circular Economy
	Sustainable supply chains
	Industrial symbiosis/metabolism
	Urban symbiosis/metabolism
	Planetary boundaries
IE-related tools	Life Cycle Assessment/LCA
	Material Flow Analysis/MFA
	Environmentally Extended Input-Output Analysis/EEIOA

Table 3: Overview of the ethics-related search terms used to identify papers explicitly discussing ethics.

Category	Search Term
General	Ethics
Principle-based	Virtue ethics
	Deontology
Outcome-based	Utilitarianism
	Teleological ethics
Applied ethics	Environmental ethics
	Care ethics

This first literature review provides a qualitative overview of the ethical theories that are currently being applied, as well as recurring themes and patterns in their application. Since they are drawn from various IE-related domains, the findings serve as a holistic overview of the current ethical landscape in the field.

2.2 Case Studies

After evaluating the explicit discussions of ethics in IE research, this study continues to explore the *implicit* ethical perspectives in the remaining IE-related research and examines whether they align with these findings. Achieving this, however, requires narrowing down the focus to specific subfields. To this end, two separate case studies are conducted.

All research inevitably makes some normative claims, yet these are rarely mentioned directly. To uncover any underlying assumptions, therefore, I conducted one case study on the green growth versus degrowth debate and another on the anthropogenic impacts on nonhuman animals. Although both case studies are closely linked to IE, their nature differs significantly: the first is more policy-oriented, while the second is more issue-specific. This contrast allows for a careful comparison of their findings, contributing to a more comprehensive understanding of the character and effects of implicit moral assumptions in IE-related research.

For both case studies, academic papers and grey literature within their respective fields were analysed in the form of a literature review, with the aim of mapping what moral assumptions are made, which ethical theory they fit best, and how they shape the resulting outcomes and recommendations.

The moral assumptions in most papers could not be reliably traced back to a single ethical theory, as they often reflect elements of multiple ones. This is not surprising, given that many ethical theories overlap. Nevertheless, I made a rough estimation of which ethical theory or theories best align with the underlying moral reasoning in each case. Deontological ethics was particularly challenging to attribute, because many claims based on utility, environmental responsibility, distributive justice, or social contracts can also be framed in terms of adherence to rules, duties, or rights, making it difficult to distinguish deontological reasoning from other frameworks. Moreover, even when duties are not invoked directly, arguments related to government obligations, legal frameworks, and policy responsibilities often indirectly align with deontological principles as well.

2.2.1 Case Study 1

The first case study focuses on the debate surrounding green growth and degrowth. As discussed in the previous chapter, this subfield serves as a valuable case for examining the fundamental role of ethics in guiding policy decisions with large-scale implications.

Over the past decade, discussions about transitioning to a more sustainable economic system have become increasingly common, leading to a vast body of literature on green growth and degrowth. Given that sustainability debates are constantly evolving, it is important to strike a balance between established research and emerging studies to get an accurate picture of the scientific discourse.

To achieve this, the scope of the analysed literature is determined based on its year of publication, with older papers requiring a higher citation threshold than newer ones, since they

have had more time to accumulate them. Based on this approach, the following criteria were used to find literature for this first case study:

Literature from before 2015: at least 200 citations.
Literature from 2015-2019: at least 150 citations.
Literature from 2020-2023: at least 100 citations.
Literature from 2024/2025: at least 5 citations.

For this literature research, only Google Scholar was used as a search engine to keep the number of citations consistent. In total, I analysed 29 papers that fit this scope. For each paper, the following aspects were identified: (1) whether the paper supported green growth or degrowth (or another alternative), (2) which main moral assumptions were made, (3) which implicit ethical theory or theories best fit these assumptions, and (4) the impact these assumptions had on the outcomes and recommendations of the paper. The AI prompt used to analyse the papers can be found in Appendix A.

2.2.2 Case Study 2

The second case study is centred around the anthropogenic impacts on nonhuman animals. As mentioned earlier, this issue is interwoven with a wide range of IE-related subfields, but often remains under-prioritised.

To assess how and to what extent nonhuman animals are considered in IE-related research, its scope mirrors that of the literature review on the explicit use of ethics by using the same IE-related search terms. However, this time decisions that (indirectly) affect nonhuman animals need to be addressed in the papers as well. Therefore, I used three search terms to combine with the IE-related ones to find papers using Google Scholar. These search terms can be found in Table 4. In total, I analysed 24 papers. For each paper, the following aspects were identified: (1) which main moral assumptions were made, (2) which implicit ethical theory or theories best fit these assumptions, and (3) the impact these assumptions had on the outcomes and recommendations of the paper. The AI prompt used to analyse the papers can once again be found in Appendix A.

Table 4: Overview of the nonhuman animal-related search terms used to combine with IE-related search terms.

Nonhuman Animal-Related Search Term
Animals
Livestock
Biodiversity

2.2.3 Information Gaps

Given the overview of the ethical landscape and the common patterns that have been identified in the literature, careful conclusions could be drawn about the evaluative ground that is shared among the analysed literature. Nevertheless, inevitable gaps and questions remained. These are listed after the case study results.

2.2.4 Delphi Study

Drawing on the tentative conclusions of the literature review and the identified information gaps, I used the Delphi method to consult expert opinions, both to scrutinise these conclusions and to address the gaps.

The Delphi method is an iterative research technique commonly used when knowledge about a complex problem is incomplete. It involves collecting anonymous expert judgements through multiple rounds of surveys, with feedback provided after each round. An updated survey that incorporates the responses from the previous round is then designed for the next round. This method aims to improve understanding and build towards consensus in a natural manner through iterative feedback. (Skulmoski et al., 2007)

To ensure representation of diverse and relevant expertise, the panel of participants includes researchers and PhD candidates with experience in the respective case study fields, alongside ethicists and philosophers of science. These experts were identified through the staff pages of TU Delft and Leiden University, by scanning for relevant research topics. I contacted them using the email addresses provided on these pages. Other stakeholders, such as staff from institutions like the European Commission and organisations like Greenpeace, were also approached, but either declined to participate or did not respond. A template of the invitation email can be found in Appendix B. For the remainder of this report, those who agreed to participate will collectively be referred to as experts.

In each round, two versions of the anonymous online survey were distributed, each tailored to one of the case studies, enabling participants to review and discuss practical examples. The surveys were designed and conducted using Qualtrics software. A data management plan, checklist, and templates of the informed consent forms were sent to the TU Delft Human Research Ethics Committee (HREC) and was subsequently approved. The study follows the conventional three-round design:

Round 1: The first two surveys were designed and sent to the experts who responded to the invitation email and signed the informed consent form. Three days before the first-round survey deadline, a friendly reminder was sent to those who had not yet responded to the invitation. Each survey comprised six open-ended questions (seven for case study 2) and required approximately 15–40 minutes to complete, depending on the depth of detail provided. The participants received two weeks to complete the survey. After the deadline passed, the responses to each question were summarised to be used for the second round. The survey questions and summaries can both be found in Appendix E.

Round 2: Alongside the same questions as before, the participants received aggregated summaries of the responses that were given per question in the previous round. Question 1 (in both versions) also received a small clarification in the second-round surveys (see Appendix E). The respondents now got the opportunity to expand upon or revise their earlier answers. This time, they also had to share their agreement with the central argument of each question on a Likert scale from 1 to 10. Providing this score, however, was not mandatory. This time, the participants received ten days to complete the survey. Afterwards, the responses were summarised again (see Appendix E) and used for the final round.

Round 3: The final round followed a similar process to the second but focused on allowing participants to converge towards a consensus. The participants received nine days to complete this survey. A summary of these final responses can be found in Appendix E.

The results from the Delphi study were used to develop a holistic moral framework that could be used to design a tool that makes it easier for sustainability researchers to scrutinise research outcomes, policy recommendations, and their underlying moral assumptions.

2.3 Framework and Tool Development

To determine what kind of tool could be developed to help assess the moral assumptions in IE research more systematically, a supporting framework first had to be established. This framework needed to serve as a reference point to help researchers scrutinise the moral dimensions of any research related to sustainability. As such, it had to respect moral pluralism, accommodate different worldviews and cultural contexts, and remain descriptive rather than prescriptive. To avoid built-in bias, it also needed to be interpersonal, interspecies, and interdisciplinary.

Based on the literature research and Delphi study, a set of four key premises were formulated that together form a coherent argument for this new moral framework, called the Descriptive Holistic Moral Framework (DHMF). From this framework, a new tool in the form of an overview was developed for practical use by researchers, as well as other stakeholders. In addition to reflecting the dimensions emphasised by the DHMF, the tool also had to meet several practical requirements. First, it needed to be intuitive to use and adopted voluntarily; making its use mandatory would be neither realistic nor desirable at this stage. Second, it had to encourage researchers to reflect explicitly on the normative assumptions made in their work, as well as on the real-world impacts the implementation of their recommendations would have. Third, the output had to be easily shareable with a broader audience, including those without a scientific background. After all, especially in the context of increasing societal polarisation around sustainability issues, transparent and inclusive communication is highly desirable.

3. RESULTS

3.1 Literature Review of the Explicit Use of Ethics in IE

3.1.1 Spectrum of Ethical Theories

The number of academic papers that explicitly discuss ethics within the context of IE is extremely limited. Only Boons & Roome (2000) take a truly holistic perspective on the role of ethics in IE similar to this research. They argue that IE cannot and should not remain purely objective, as it is inherently normative. While normative assumptions are necessary, they say, these positions should be made explicit and subjected to debate and scientific inquiry. Keitsch (2011) takes a broader perspective as well, but still prescribes a specific approach in the form of anthropocentrism supplemented by moderate biocentrism.

The Journal of Industrial Ecology has published very few papers that directly engage with ethics, with only two known examples, both of which apply less conventional ethical theories that can be classified as distributional ethics. Heide & Gjerris (2024) take a broader perspective but ultimately advocate for a specific approach (sufficientarianism), although they do explicitly mention the moral assumptions they base this approach on (referred to as ethical premises). The other paper, Hjalsted et al. (2021), discusses multiple ways to allocate environmental burdens in a relatively neutral way, although the authors do favour principles of equality and helping the worst off (egalitarianism and prioritarianism) over precedent-focused ones (grandfathering).

Beyond these four, Oyewole (2001) is the only other paper that directly links ethics to IE, advocating for social contract theory and the business-focused applied ethics of integrative social contracts theory to achieve environmental justice. The occurrence of each ethical theory in these papers can be seen in Table 5. A complete overview of the ethical theories, moral assumptions, and outcomes and recommendations of each paper can be found in Table C1.

Table 5: Overview of the ethical theories discussed in papers that explicitly address ethics and IE.

Ethical Theory Discussed	Occurrence
Distributional ethics	7
(Egalitarianism)	(2/7)
(Prioritarianism)	(2/7)
(Grandfathering)	(2/7)
(Sufficientarianism)	(1/7)
Environmental ethics	1
(Moderate biocentrism)	(1/1)
Utilitarian/teleological ethics	2
Anthropocentrism	2
Deontology	1
Social contract theory	1
Integrative social contracts theory	1

Spectrum of theories in IE-related fields

The ethical theories applied across IE-related fields, including the CE, sustainable supply chains, and planetary boundaries, are highly varied, ranging from utilitarianism and deontology to care and virtue ethics, environmental ethics, and even religious ethics. On industrial and urban symbiosis/metabolism no literature explicitly discussing ethics could be found.

When we map the use of ethical theories to see how they are applied, some interesting trends and tensions emerge. Although not unanimously, principles including fairness, justice (social and environmental), inclusivity, interdisciplinarity, and intergenerational and non-anthropocentric responsibility are all strongly advocated for.

Utilitarianism is both supported by a paper (Tukiran et al., 2023) and critiqued by others, since it may overlook inequalities and social justice concerns (Ashton et al. (2022), Gunawardhana (2024), Nilsen (2024)). Deontological ethics is therefore often used to contrast with purely utilitarian perspectives. Conversely, care ethics is applied particularly to stress the importance of relational responsibilities, contextual decision making, interdependence, and mutual well-being in favour of rigid and universal moral duties.

Non-anthropocentric ethics in its various forms, including environmental ethics, ecocentrism, deep ecology, organicism, and Christian and Islamic environmental ethics, is mainly used to advocate for principles related to ecological justice, planetary responsibility, long-term environmental protection, as well as nonhuman and intergenerational well-being. Next to this, some papers also contrast voluntary ethical responsibilities with legal responsibilities, with some studies arguing that legal enforcement is necessary, while others believe cultural and corporate ethics are sufficient.

Alam et al. (2025) takes a different approach from the other papers and discusses a psychological framework that impacts our moral decision making instead of an ethical theory itself. In doing so, they point out that environmental decision making cannot and should not be separated from behavioural science.

Only three papers take a more holistic, descriptive approach to the role of ethics in IE-related fields (Sergejeva (2023), Karimova & LeMay (2024), Paulraj et al. (2015)). Rather than prescribing a single ethical theory, they critically discuss multiple and advocate for a kind of ethical pluralism, arguing that no single ethical theory is sufficient to tackle all facets of the sustainability challenges we are facing. Instead, they call for a more nuanced and integrative ethical approach. An overview of the ethical theories that were discussed in all of the papers can be found in Table 6. A complete overview of the ethical theories, moral assumptions, and outcomes and recommendations of each paper can be found in Table C2.

Table 6: Overview of the ethical theories discussed in papers that explicitly address ethics in IE-related fields.

Ethical Theory Discussed	Occurrence
Environmental ethics	8
(Ecocentrism)	(2/8)
(Deep ecology)	(1/8)
(Non-anthropocentrism)	(1/8)
(Ecofeminism)	(1/8)
(Organicism)	(1/8)
(Environmental ethics)	(1/8)
Utilitarian/teleological ethics	7

Ethical Theory Discussed	Occurrence
Virtue ethics	6
Care ethics	4
Deontology	4
Christian business ethics	1
Christian theological ethics	1
General discussion of justice	1
General discussion of principles	1
General discussion of non-epistemic values	1
Value-belief-norm theory (psychological framework)	1

Spectrum of theories in IE-related tools

The number of academic papers that explicitly discuss ethics within the IE-related tools of LCA, MFA, and EEIOA is once again extremely limited. On EEIOA, no literature showed up at all with the search terms I used. The majority of the literature that has been published, however, does take a holistic view on the role of ethical theories, particularly in LCA but also in MFA.

The most commonly discussed theories are once again utilitarianism, deontology, and different types of environmental ethics. Three papers look specifically at the values that underpin LCA and reject the idea of value neutrality in sustainability assessments (Freidberg (2018), Steen (2006), Finnveden (1997)). Brander et al. (2019) and Ekvall et al. (2005) stress the importance of combining multiple ethical perspectives, and Birat (2019) argues there is a clear need for ethical pluralism and interdisciplinary cooperation.

Only two papers advocate for a specific ethical theory. Weidema & Brandão (2015) favour a utilitarian, damage-based approach in the context of life cycle impact assessments and planetary boundaries, and Schiller (2009) favours communication-focused discourse ethics in the context of MFA. An overview of the ethical theories discussed in these papers can be found in Table 7. A complete overview of the ethical theories, moral assumptions, and outcomes and recommendations of each paper can be found in Table C3.

Table 7: Overview of the ethical theories discussed in papers that explicitly address ethics in IE-related tools.

Ethical Theory Discussed	Occurrence
Utilitarian/teleological/consequentialist ethics	6
Deontology	6
Environmental ethics	5
(Biocentrism)	(2/5)
(Ecocentrism)	(1/5)
(Pathocentrism)	(1/5)
(Holism)	(1/5)
Anthropocentrism	2
Virtue ethics	1
Discourse ethics	1
General discussion of justice	1
General discussion values and scientific objectivity	1

3.1.2 Common Patterns

None of the papers that directly address the field of IE make moral assumptions based on principles that are not ultimately justified through outcome-based reasoning. For instance, Oyewole (2001) argues that fairness in the distribution of environmental impacts is a moral duty, which is one of the few claims that might initially appear non-consequentialist. However, this assertion is supported by the aim of avoiding practices that systematically worsen the situation of a given group in society. In this light, the duty is not considered moral in itself, but moral because of its desirable consequences.

Similarly, Keitsch (2011) argues that nature has value beyond the instrumental by discussing intrinsic moral values and rights associated with nonhuman life. However, their inclusion is again justified through outcome-based reasoning, emphasising the pragmatic benefits for researchers as well as the experiential benefits for future generations and nonhuman animals themselves.

The literature clearly highlights the central role of experiential consequences in decision making within IE-related research. In particular, several papers emphasise the risk of underrepresenting the experiences of specific groups, such as nonhuman life, marginalised communities, and future generations, and stress the need to include these perspectives in future IE research.

The moral principles discussed in papers from IE-related fields and tools, including duties, virtues, and responsibilities, are also consistently justified using outcome-based reasoning. For instance, Gunawardhana (2024) makes the assumption that moral responsibility extends beyond outcomes to processes, meaning our decision making must include Kantian (deontological) ethics. While this position is grounded in deontological ethics and care ethics, the justification of these duties is framed in consequentialist terms, particularly through the emphasis on preventing harm to workers, marginalised communities, and underdeveloped countries.

Similarly, Drake & Schlachter (2008) assume that trust, fairness, reciprocity, and cooperation are important moral principles. Once again, however, their justification for these virtues primarily appeals to the improved long-term outcomes for the firms and individuals involved. In general, due to the nature of sustainability research itself, moral principles are rarely presented as self-evident or independent from their effects; they are supported by pointing to the favourable consequences they bring compared to continuing the status quo.

Lastly, what also stands out is how recent most of the papers are. This increase in ethical discussions over the past years may reflect a broader recognition that sustainability challenges are not merely technical but also moral in nature.

Overall, based on this literature from IE-related fields and tools, the central role of experiential consequences is once again revealed. For these papers specifically, the potential underrepresentation of the experiences of nonhuman life, informal and care workers, gendered labour perspectives, and future generations are at the centre of the moral issues that are addressed.

3.1.3 Overview of the Ethical Landscape in IE

As this literature review has shown, despite all sharing the domain of IE, there is no consensus on what ethical approach IE research should take. This demonstrates that IE research

engages a broad spectrum of ethical approaches, but with varying depth and no single dominant ethical paradigm, suggesting that ethical theories might be functioning more like heuristics. Nonetheless, regardless of the ethical theory used, moral assumptions seemed to be reliably justified through some form of outcome-based reasoning.

Research in IE clearly faces not only technical challenges, but also profound moral ones. Yet when critiquing the status quo, researchers often appear to choose ethical theories that emphasise particular principles or prioritise outcomes for certain groups, especially those that best support their arguments. This implicitly assumes that policymakers, industry leaders, or even the media will share the view that a particular ethical theory is universally valid and exclusive in its authority, which is unrealistic to expect in practice. This is particularly clear in a paper like Oldak (2023) who grounds their moral argument in religious texts. As a result, ideas and criticisms are routinely tested within self-justifying theories, reinforcing their own premises rather than being critically examined against a holistic benchmark. Too often, even with the best intentions, researchers effectively act as judge, jury, and prosecutor in their own ethical trials.

A clear vision of a scientifically humble and holistic framework is offered only by those who adopt a descriptive, interdisciplinary, and integrative approach, such as Birat (2019), who treats deontology, utilitarianism, virtue ethics, and ecocentric ethics as complementary tools, explicitly using them as if they were heuristics. While this pluralistic approach brings methodological complexity, it better equips us to address sustainability challenges coherently and inclusively. Such a framework views ethical theories not as mutually exclusive, but as a diverse toolkit for guiding how human societies and the natural environments they inhabit can flourish now and in the future.

3.2 Case Studies

3.2.1 Case Study 1: Green Growth vs Degrowth

Spectrum of implicit ethical theories

An analysis of the literature on green growth and degrowth shows that advocates of green growth typically base their arguments on moral principles that emphasise economic stability and social well-being, advocate minimising environmental damage, and uphold human prosperity within sustainable limits (often through government-driven policies, thoughtful policy design, and technological innovation). In other words, utilitarianism, anthropocentrism, and social contract theory are most dominant in green growth literature.

In contrast, degrowth advocates tend to base their arguments on the intrinsic value of nature and the necessity of respecting planetary boundaries. They call for equitable resource allocation, wealth redistribution, and an economic restructuring that supports fair labour, community self-governance, and overall well-being. As a result, environmental ethics, distributive ethics, and care ethics play a central role in degrowth literature.

Next to the papers that take a relatively clear stance in the debate, there are also papers that take a broader or more nuanced perspective. For example, Savin & van den Bergh (2024) take an overarching view of degrowth literature and mainly critique it for being opinion-based. The assumptions they identified can be categorised into environmental and distributional ethics. Van den Bergh (2011) also critiques degrowth, but advocates for a-growth (defined by the author as "*being indifferent about growth*") rather than green growth, based on assumptions mostly stemming from utilitarianism, environmental ethics, and social contract theory.

Which implicit ethical theories were applied in the literature analysed for this case study can be found in Table 8. An overview of the theories that were applied per paper, as well as their stance in the green growth versus degrowth debate, can be found in Table D1. A complete overview of the main moral assumptions that were made and the impact they had on the outcomes and recommendations can be found in Table D2.

Table 8: Overview of the best-fitting implicit ethical theories applied in papers on green growth and degrowth.

Ethical Theory Discussed	Occurrence
Environmental ethics	25
Distributional ethics	25
Utilitarianism	17
Social contract theory	12
Care ethics	11
Anthropocentrism	7
Virtue ethics	4
Deontology	1
Religious ethics	1
Technological optimism (not a traditional ethical theory)	1

Common patterns

Despite differences in the exact recommendations, there seems to be a lot of coherence in the moral foundation of the papers. It appears that when no ethical theories are explicitly applied, many decisions seem to be justified using similar patterns.

Both green growth and degrowth perspectives agree that environmental degradation and social inequality are problems. There is broad consensus that current economic and societal structures must adapt to avoid ecological collapse or severe environmental degradation. There also seems to be an agreement on prioritising well-being over using GDP as the (only) indicator of societal progress.

Next to this, both green growth and degrowth arguments frequently invoke aspects of distributional ethics (fairness), environmental ethics (ecological responsibility), and utilitarianism (maximising well-being). However, they reach different conclusions about what these demand in practice. This suggests that these disagreements might not be insurmountable but instead stem from variations in the information available to the researchers and the methodological approaches used to interpret that information. This indicates an interesting pattern.

Not all disagreements in sustainability decision making are created equal. As Waas et al. (2014) note in their work on sustainable development strategies, "*[…] (scientific) information is just one of the factors influencing decision-makers*". Similarly, Morse & Bell (2011), reflecting on sustainability indicators, argue that "*[…] indicator development and interpretation is more art than science and the room for subjectivity in all stages of their application is large*". These insights suggest that disagreements can, in fact, stem from many sources. Therefore, before concluding that a disagreement is fundamentally moral in nature or even irreconcilable, it is important to consider whether it might instead be the result of other differences. Based on this, disagreements can be said to fall into three, potentially overlapping, categories.

First, a disagreement can be caused by a difference in the available information. If both sides had access to identical information, the disagreement would likely be resolved. This can therefore be classified as an *information-based disagreement*. Examples of such disagreements are abundant in the analysed literature. One example comes from Hickel & Kallis (2020), who argue that green growth should be abandoned as a policy objective, because it lacks empirical support. This is contrasted by Stoknes & Rockström (2018), who argue genuine green growth (defined as growth that meets specific science-based thresholds) is both empirically observable (e.g. in Nordic countries) and more politically feasible than degrowth. If both sides had access to the same data, the disagreement might be settled relatively easily.

Second, a disagreement can be caused by differences in reasoning. In this context, reasoning refers not to differing moral worldviews, but to the epistemic or methodological differences that researchers adopt. This may involve different starting points (e.g., what constitutes a meaningful sustainability target), differing beliefs about causal relationships (e.g., whether decoupling GDP from environmental impact is feasible), varying priorities among shared values (e.g., weighing political feasibility and ecological urgency), or divergent standards of plausibility and proof. In other words, these disagreements are the inevitable result of a world where perfect knowledge is unachievable. However, if both sides interpreted the available information in similar ways using similar epistemic or methodological standards,

the disagreement might be resolved. This can therefore be classified as a *reasoning-based disagreement*.

Since these disagreements often overlap with information-based ones, they are difficult to isolate. After all, different researchers never work with exactly the same data. Nevertheless, examples can be found in the literature. For instance, Schneider et al. (2010) argue that even if GDP declines, well-being can increase, and that degrowth should be a deliberate objective. Van den Bergh (2011), on the other hand, argues that targeting GDP degrowth directly would not be helpful, since GDP is a poor proxy for environmental impact and well-being. The empirical evidence they reference may be similar, but the way they reason about the causal relationship between GDP, environmental impact, and human well-being leads them to different conclusions. By adopting a common framework for evaluating how economic indicators relate to societal goals, they could more readily find common ground.

Third, a disagreement can be about what is fundamentally right and wrong. If both sides have access to similar information and reason similarly as well, they might still disagree about the right way forward, and ultimately, about which goal should be pursued. This can therefore be classified as a *fundamentally irreconcilable disagreement*. No amount of new knowledge or shared reasoning could resolve it. Such disagreements are impossible to reliably isolate in the literature, because at least some differences in information or interpretation are always present. However, when we look beyond these differences and consider the broader goals that each paper strives for, it appears this type of disagreement rarely shows up.

After all, despite their divergences, the vast majority of reviewed papers explicitly support intergenerational justice, social equity, ecological sustainability, and a fair and sustainable economic system. None explicitly deny the importance of marginalised communities, care workers, future generations, or nonhuman animals either. Rather, each tends to focus on specific groups whose experiences reinforce their broader strategic arguments. As a result, many moral assumptions in the literature appear to reflect underlying differences in information or reasoning, rather than fundamentally opposing moral views. This, in turn, highlights the significance of clear and effective communication.

While different papers emphasise the importance of different groups, their assumptions nevertheless consistently derive their significance from *experiential perspectives*. For example, arguments in the literature from a utilitarian perspective explicitly prioritise maximising well-being and minimising suffering. As such, by definition, these moral assumptions get their strength from consequences related to the experiences of people and nonhuman animals.

Arguments from a care ethics perspective explicitly emphasise the experiences of people in the context of relationships, particularly focusing on mutual care and interdependence. Especially by focusing on the perspective of caregivers, the assumptions stemming from this ethical theory also get their strength from the experiences of a particular group of people.

Those from a distributional ethics perspective explicitly deal with fairness and the equitable distribution of resources. These assumptions once again only make sense because the status quo results in unacceptable consequences for the experiences of underrepresented groups.

Nevertheless, arguments that have been identified as stemming from environmental ethics or deontology can sometimes be said to implicitly invoke foundational principles, such as the intrinsic value of ecosystems or a duty to respect planetary boundaries. While these principles are compelling, it would be difficult to meaningfully separate them from their implications for the lives of vulnerable communities, nonhuman animals, or future generations. Since ethics is

not discussed explicitly in these papers, these principles are never described as existing separately from any consequences either. After all, introducing such principles without critical justification (i.e., expecting them to be accepted at face value) would risk stifling scientific debate through well-reasoned and falsifiable claims.

Moreover, in practice, the moral relevance of such principles tends to be context-dependent. Consider the example of a "business": it is a conceptual construct rather than a single physical entity, because it ultimately consists of assets, services, people, and relationships. Its moral relevance *emerges* from the effects it has both on those who constitute it and those it impacts.

The same holds for "ecosystems" such as forests and rivers. These, too, are conceptual constructs, defined by interactions between biotic and abiotic components. Their moral value does not exist in isolation but instead arises through their importance to the lives of nonhuman animals that depend on them and the humans who care about their preservation. In both cases, moral relevance emerges from the lived experiences involved, not from the conceptual construct itself.

Consequently, this literature review reveals two key insights. First, most moral assumptions in green growth and degrowth papers appear to arise mostly from information-based and reasoning-based disagreements, rather than from fundamentally insurmountable moral differences. In fact, there seems to be at least some form of shared evaluative ground transcending the disagreements. Second, this shared ground appears to be based on *experiential information* (who is affected by a decision, how they are affected, and for how long).

Notably, the full spectrum of groups identified as morally relevant across the literature, whether in support of green growth or degrowth, ultimately encompasses all sentient beings. This suggests that moral arguments challenging the status quo seem to derive their moral significance from the quality of the experiential consequences involved. Crucially, the experiences that appear most underrepresented are those of vulnerable workers, caregivers, Indigenous and marginalised communities, people from the Global South, nonhuman life, and even policymakers having to navigate complex transitions.

3.2.2 Case Study 2: Anthropogenic Impacts on Nonhuman Animals

Spectrum of implicit ethical theories

What immediately stands out in the literature making (indirect) decisions about the anthropogenic impacts on nonhuman animals is that an implicit anthropocentrism is overwhelmingly present across nearly all papers. Nonhuman animals are consistently framed primarily as resources (either economic or environmental) that are instrumental to human well-being and productivity. The needs of individual animals are not outright dismissed but rather omitted frequently.

Utilitarianism is often combined with anthropocentrism, particularly where the optimal solution is defined as maximising human benefit. When arguments implicitly invoke environmental ethics, they primarily emphasise ecosystem-scale value. Biodiversity is almost exclusively valued for its ecosystem services rather than for the welfare of individual animals themselves.

Only Anne et al. (2018), Buchmann-Duck & Beazley (2020), De Rosa et al. (2021), and Wiengarten & Durach (2021) directly address the perspective of the animals themselves, and all argue that their welfare needs to be taken into account. This implies once again that when nonhuman animals are *not* ignored, it is unlikely their needs will be dismissed or trivialised. The omission in the remaining papers may simply be due to limited scope, differing priorities, or practical convenience. After all, animal welfare is a particularly complex issue to address. However, this repeated exclusion might result in structural moral blind spots that can undermine the comprehensiveness and legitimacy of sustainability research.

None of the papers take a primarily descriptive approach by trying to assess how the needs of nonhuman animals are being weighed. Instead, a prescriptive conclusion is always drawn, whether explicitly or implicitly.

Which implicit ethical theories were applied for each paper can be found in Table 9. An overview of the implicit ethical theories that were applied per paper can be found in Table D3. A complete overview of the main moral assumptions that were made and the impact they had on the outcomes and policy recommendations can be found in Table D4.

Table 9: Overview of the best-fitting implicit ethical theories applied in papers making (indirect) decisions about the anthropogenic impacts on nonhuman animals.

Ethical Theory Discussed	Occurrence
Anthropocentrism	21
Utilitarianism	19
Environmental ethics	18
(Ecocentrism)	(14/18)
(Biocentrism)	(3/18)
(Pathocentrism)	(1/18)
Distributional ethics	4
Social contract theory	2
Care ethics	2

Common patterns

Just as in the previous case study, truly irreconcilable moral disagreements are exceedingly rare. Instead, conflicts primarily stem from differences in the information being discussed and the reasoning used to interpret it.

Likewise, debates over human impacts on nonhuman animals rest on the same evaluative ground of experiential information we see in the green growth and degrowth literature. However, the problem of inconsistent application becomes even more apparent in this context. By making the underlying ethical theories explicit and fully acknowledging the lived consequences for every affected group, including nonhuman animals, we might be able to move towards more consistent outcomes and recommendations.

3.2.3 Information Gaps

Despite differences in how sustainable economic systems are designed or how nonhuman interests are weighed, there seems to be a clear, underlying evaluative ground. After all, effective sustainability research needs some form of moral reference point that considers all affected parties, human and nonhuman beings alike. Yet because this foundation is undefined,

implicit, and applied inconsistently, incoherence and ineffectiveness persist. This raises crucial questions for IE research. In all of the literature, whatever principles (i.e., values, rights, virtues, rules, contracts, or duties) researchers invoke to challenge the status quo, they all derive their relevance from how well they improve outcomes for those involved.

Especially when utilitarian reasoning governs decisions about nonhuman animals, we must ask: for whom are we maximising utility? Humans alone, or all sentient beings? The literature from the second case study seems to assume the former without stating it explicitly. That omission prompts another question: if these papers openly addressed animal welfare, where would they stand?

Could every sustainability argument, regardless of ethical theory, ultimately be traced back to concerns about the quality and distribution of experiences among all sentient beings? If so, this has major implications for scrutinising assumptions in the field. Could we evaluate the morality of our decisions purely by weighing experiential information? And would the only barrier to moral consensus then be our inability to gather and communicate complete and accurate information and reasoning?

Furthermore, if moral relevance extends only to sentient beings, then ecosystems and nature as wholes gain value only through their impact on those who experience benefits from them. And should we then also determine an animal's moral weight by the complexity of its experiences? To begin answering these questions, and to build a more coherent, inclusive moral framework for sustainability research, I have consulted experts who can critically challenge and refine these conclusions.

3.2.4 Delphi Study

Across the different rounds of the Delphi study, most respondents gradually moved towards a degree of consensus, with increasing explicit agreement on the views reflected in the aggregated summaries. Although response counts declined slightly in later rounds, participants consistently provided thoughtful and detailed responses.

The first question was designed to assess whether respondents recognised common patterns in the disagreements I had identified during the literature review of case studies. However, many interpreted the question differently, leading them to respond to a different issue than originally intended. In particular, the term "moral foundation" was often misinterpreted as referring to a single, prescriptive ethical theory, rather than the shared evaluative ground based on common concerns and goals in sustainability research. While respondents strongly rejected the idea of imposing a single ethical framework on sustainability research, they did appear to agree that fundamental differences in researchers' worldviews cannot be resolved through better information or reasoning alone. Respondents also emphasised the importance of clarifying key terms, such as "well-being" and "sustainability", noting that divergent definitions can themselves be a source of disagreement. Overall, the panel of experts concluded that moral pluralism is both inherent and persistent, and identified it as a primary source of disagreement within sustainability research.

When asked about the need for an interpersonal and interspecies moral foundation to support coherent and effective decision making, some respondents again interpreted this foundation as prescriptive rather than descriptive. As a result, they argued that applying a single moral standard to evaluate sustainability research would be both unrealistic and overly rigid, potentially stifling valuable diversity. Nevertheless, there was broad agreement that

making moral assumptions explicit is important, as it helps clarify underlying values, identify areas of common ground, and support more transparent decision making around trade-offs. In the end, respondents expressed a clear preference for transparent moral pluralism over the imposition of a fixed set of prescriptive criteria.

The two questions exploring the justification of moral principles, along with the question addressing the role of experiential information, elicited responses that largely followed similar lines of reasoning. Most respondents acknowledged the importance of outcomes in sustainability-related moral reasoning, and even those who prioritised principles often justified them by appealing to their associated results. Views were more divided on the fundamental role of sentient experience in determining moral relevance. Notably, there was some ambiguity around the definition of "sentient beings", with differing opinions on which animals, or even ecological systems, might qualify. Some respondents viewed sentient experience as essential to moral relevance, while others saw it as insufficient on its own, pointing instead to symbolic harms, relational worldviews, or the intrinsic value of non-sentient nature.

Many objections to a strictly experience-based ethics referred to hypothetical examples rather than common, real-world cases. A minority supported non-consequentialist ethics but acknowledged that such principles tend to be context-sensitive and rarely absolute. While other metrics, such as rationality or justice, were also mentioned, it could be argued that these are inextricably linked to experience as well. Among the majority who recognised the importance of experiential information, several noted practical concerns, especially noting the difficulty of gathering and comparing such data for future and nonhuman stakeholders. In the additional question included in the version of the survey adapted to case study 2, there appeared to be agreement on the importance of considering the complexity of nonhuman animal experiences when comparing them to those of humans. Overall, the consensus was that principles and experiential consequences should complement one another as part of a pragmatic, pluralistic evaluative approach.

In the final question, designed to assess whether studying and communicating experiential information could help approximate the ideal of a more objective and complete moral foundation, the panel seemed to find most agreement. Respondents emphasised that researchers, particularly those based in the Global North, should avoid speaking on behalf of others and instead create space for affected communities to articulate their own experiences. This aligns with a more descriptive and inclusive approach. Several also noted the importance of a reasonable epistemic cut-off to prevent inaction; when urgent action is needed, it should not be postponed in pursuit of ever more precise information. While acknowledging that clarity alone cannot guarantee consensus, most agreed that experiential information meaningfully strengthens moral reasoning and is essential for developing persuasive and inclusive arguments.

When considered alongside the findings from the literature review, the responses indicate that some participants hold a more sceptical view regarding the extent to which moral assumptions in sustainability research are implicitly grounded in experiential consequences for both humans and nonhuman animals. Improving clarity around the types of arguments used in practice may help to reduce discrepancies in expert perceptions. Overall, the value of experiential information, the importance of making moral assumptions explicit, and the need for transparent, constructive collaboration were all strongly affirmed across the Delphi study.

3.3 Framework and Tool Development

3.3.1 Descriptive Holistic Moral Framework (DHMF)

The literature review reveals that practically all disagreements in sustainability research are information-based or reasoning-based. Nonetheless, even deep-rooted moral assumptions often emerge from these disagreements. Next to this, implicit moral pluralism can lead to inconsistent and self-reinforcing conclusions. This highlights the need for a shared framework that allows researchers to systematically examine the moral foundations of their work without itself imposing a single prescriptive stance.

    Findings from the Delphi study reinforce this need. The panel of experts acknowledged the value of an integrative approach to scrutinising moral assumptions but emphasised that any standard must avoid enforcing moral judgements itself. Next to this, there is a need for clear and accessible information that is sufficient to start tackling urgent problems instead of delaying them because of inevitable uncertainties. As a result, a careful argument for such a descriptive framework can be built.

Premise 1:

To systematically and convincingly scrutinise the moral assumptions that underpin IE research and their resulting recommendations, researchers need a shared, descriptive framework.

While some Delphi participants were sceptical of grounding moral reasoning solely in outcomes, the literature demonstrates that desirable consequences reliably serve as core justifications for the moral assumptions made in sustainability research. In practice, decisions about what is worth sustaining, and how, are consistently guided by the favourable future those efforts are expected to bring about. Importantly, even the Delphi panel acknowledged that outcomes play a critical role when invoking moral principles, even if those principles are not outcome-based in origin. This leads to a second premise.

Premise 2:

In practice, IE research justifies the moral principles it applies by appealing to the desirable outcomes those principles are expected to deliver.

While some Delphi respondents mentioned hypothetical exceptions, the desirable outcomes appealed to in the literature are consistently framed in terms of the experiences of people and animals. In the context of sustainability research, this seems intuitively justified. After all, what would be the point of sustaining something if it made no difference to the lived experiences of anyone, human or nonhuman, now or in the future? In addition, papers rarely deny moral relevance to any group of sentient beings. Instead, they sometimes omit or underrepresent them. Based on this, a third premise could be formulated.

Premise 3:
The desirable outcomes appealed to by IE research's moral assumptions are relevant for everyone capable of experiencing them; that is, every sentient being affected.

Both Delphi respondents and several authors from the analysed literature emphasised that we should not speak on behalf of others, whether Indigenous communities, marginalised groups, or nonhuman animals. In line with this, a shared, descriptive framework should avoid defining the quality of an experience on behalf of any sentient being. Despite practical challenges, it should aim to represent experiential outcomes as faithfully as possible from the perspective of the experiencer themselves. This results in a final premise.

Premise 4:
The quality of an experience can only be truly assessed by the sentient being who undergoes it.

While experiential information was sometimes not seen as sufficient on its own, Delphi participants acknowledged its critical role in ethical analysis. Although no single prescriptive framework dominates in sustainability research, experiential information may offer a promising common denominator across ethical perspectives, one that can illuminate and perhaps even bridge moral differences. Consequently, a convincing conclusion can be drawn.

Conclusion:
A shared, descriptive framework that helps IE researchers scrutinise moral assumptions and their resulting recommendations should strive to include information about the subjective experiences of all sentient beings affected by them.

The proposed framework is referred to as the Descriptive Holistic Moral Framework (DHMF). It is designed to operate at a genuinely interpersonal and interspecies level, encompassing the full range of experiential impacts associated with any sustainability-related decision.

Given its ambition to account for all potential experiences, whether directly or indirectly affected, the framework necessarily represents a hypothetical ideal. Complete and fully accurate experiential information can never be obtained. In this light, a perfectly objective moral benchmark remains out of reach. Yet, this limitation does not diminish the framework's value. On the contrary, striving towards such an ideal can offer a coherent and inclusive foundation for evaluating the moral dimensions of sustainability research in a more systematic way.

Traditional ethical theories each have their own focus and *prescribe* specific forms of behaviour. For example, virtue ethics promotes behaviour shaped by virtuous character, deontology prescribes actions based on rights and duties, and utilitarianism advocates behaviour that maximises a particular interpretation of "utility".

By contrast, the DHMF is intended to be universal in scope, focusing instead on *describing* the cumulative experiences of all those affected as well as possible. In this way, it can supplement a top-down model of ethical reasoning with a bottom-up approach grounded in lived experience. A visualisation of this idea is shown in Figure 2.

The DHMF is not intended to replace ethical theories, nor to settle moral debates on its own. Even when all experiential impacts have been mapped, they still require interpretation and weighing, especially in the face of incomplete information and unavoidable uncertainties and trad-offs. Instead, the DHMF serves as a complementary approach; one designed to aid and clarify ethical reflection by making the lived consequences of decisions more visible. In doing so, it can help strengthen the top-down reasoning of any ethical theory with the bottom-up justification those theories often already appeal to in practice, even if only implicitly.
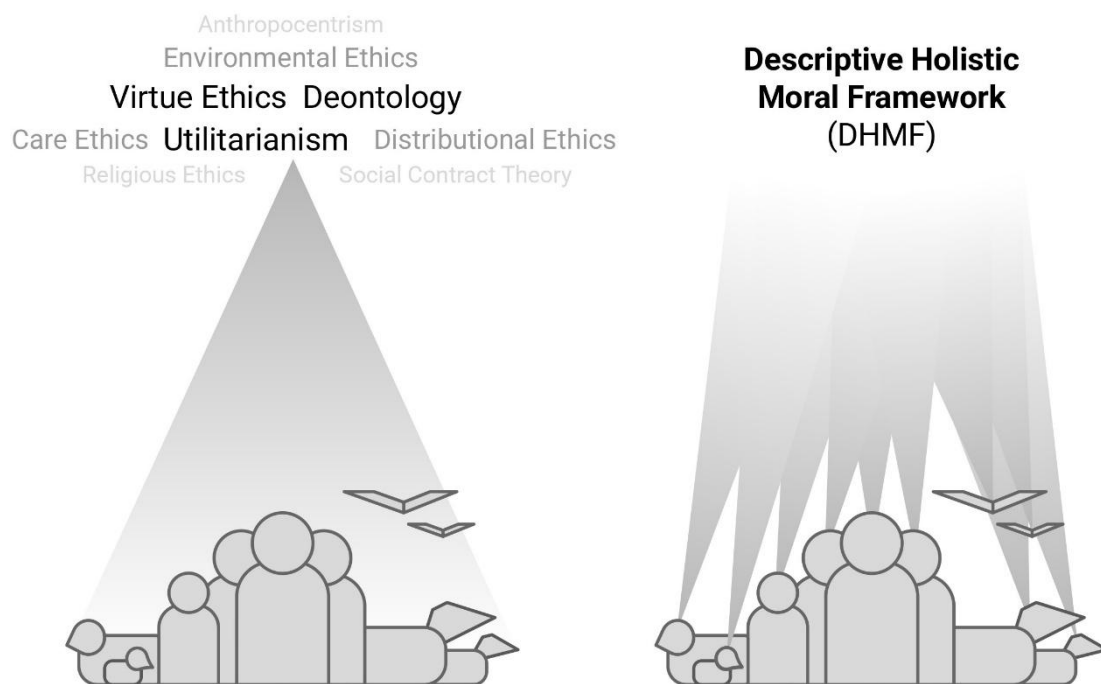

Figure 2: A visualisation comparing the top-down, prescriptive approach of traditional ethical theories with the bottom-up, experiential approach of the DHMF.

3.3.2 Holistic Moral Evaluation (HoME) Profile

Given the development of the DHMF, the next step is to translate its descriptive function into a useful tool that IE researchers can meaningfully apply. The resulting tool is a one-page overview designed to clarify the core message and potential impact of a piece of sustainability research, make its moral assumptions explicit, and improve how its findings are communicated to a broader audience. This overview is called a Holistic Moral Evaluation (HoME) Profile, and it can be added to any scientific publication related to sustainability.

The tool itself does not perform the evaluation; rather, it enables readers to do that for themselves. Importantly, the HoME Profile is not intended to replace any part of a scientific publication, but to serve as a valuable addition. While the DHMF offers a conceptual foundation for identifying and reflecting on the associated impacts of moral assumptions

made in sustainability research, the HoME Profile serves as a practical tool that applies this framework in a structured and communicable format.

To successfully fulfil its purpose, the HoME Profile should be written in accessible language. Researchers are encouraged to avoid the use of any jargon, ensuring that the profile remains understandable to readers without a scientific background. This emphasis on clarity supports the tool's aim of facilitating interdisciplinary dialogue and public engagement.

Filling in an effective HoME Profile is not a simple task. Striking a balance between scientific honesty and accessible communication often requires an iterative process and careful reflection. Researchers are therefore advised to treat the writing of a HoME Profile as an integral part of the research process, one that may benefit from external feedback, particularly from individuals unfamiliar with their work.

In the first section of the HoME Profile, researchers are asked to clarify their work's scientific contribution by explaining what it adds to the existing body of knowledge. In practice, this often means explaining what insight, method, or tool was created or improved. In the second section, they should articulate their core recommendation; that is, what they believe other researchers, policymakers, practitioners, or members of society should do with this new knowledge. If the researcher prefers not to offer a direct recommendation, this section may instead be titled "Main Conclusion" and used to summarise the key insights. In the third section, researchers are prompted to reflect on the underlying values, rights, virtues, rules, duties, or other moral principles they use to justify this recommendation or conclusion. All sections must be written in the first person to ensure clear ownership of the research and its broader implications.

The final section invites researchers to provide their best-informed estimation of how their core recommendation would affect the experiences of all relevant groups of sentient beings, compared to continuing the status quo. While complete accuracy is unattainable, the emphasis is on inclusivity and transparency. Rather than focusing only on those groups deemed most important, researchers are encouraged to identify all groups of people and animals likely to be affected.

A template of the HoME Profile, an accompanying instruction manual, and two example Profiles (one for each case study) can be found in Appendix F. It is important to emphasise that HoME Profiles should be created by researchers themselves. The examples provided were created by me solely for illustrative purposes and are not endorsed by the authors of the original papers. A HoME Profile for this thesis itself can be found on Page 2 of this report.

4. DISCUSSION

At its core, this thesis proposes that meaningful sustainability research requires not only scientific rigour but also ethical transparency and discussion. This project responds to a widespread need for more explicit ethical reflection in sustainability-related decision making through the development of the Descriptive Holistic Moral Framework and the HoME Profile. These contributions offer researchers a way to articulate the ethical dimensions of their work in a manner that is both standardised and comprehensible to a diverse audience.

Both the literature research and Delphi study show that a wide range of ethical theories and perspectives inform research in IE and related sustainability fields. While ethical pluralism is arguably inevitable, the selective use of moral principles can reinforce existing biases and lead to fragmented practical recommendations. This highlights the need for a balance between respecting diverse normative perspectives and promoting consistency and effectiveness in decision making across sustainability research.

To address this challenge, this thesis proposes that sustainability-related publications include a concise profile covering four key elements: (1) the publication's scientific contribution, (2) its main recommendation based on the findings, (3) the underlying moral assumptions, and (4) a reasoned estimate of how all affected parties would likely be impacted if the recommendation were implemented. The purpose of the DHMF and the resulting practical HoME Profile also aligns with explicit calls in the literature for greater ethical reflexivity in sustainability science. For example, Boons and Roome (2001) argue that normative positions in IE are often implicit and should be made explicit and open to critical debate. Karimova and LeMay (2024) similarly stress that the success of CE strategies and circular supply chains depends on greater normative alignment, including balancing trade-offs between moral principles and economic realities. In the context of LCA, Freidberg (2018) also notes that value neutrality is an illusion, and that greater transparency, reflexivity, and public engagement are essential to support trust and legitimacy in decision making. The HoME Profile is designed to directly facilitate these goals.

Societal and managerial implications

If used and refined at scale, the HoME Profile may support researchers and educators in better understanding, explaining, and teaching the ethical significance of their work, while encouraging more explicit reflection on its moral foundations and real-world impacts. Policymakers may also gain a clearer view of the normative dimensions embedded in the evidence they use. While policy decisions are shaped by many competing influences beyond scientific research, greater moral transparency may stimulate more reflective and potentially more inclusive decision making.

Next to this, clearer communication of ethical dimensions may help journalists and science communicators better grasp and convey the core message and moral foundations of sustainability research, thereby supporting broader public understanding of its findings and practical consequences. Greater attention could likewise be drawn to underrepresented groups, including marginalised communities and nonhuman animals, reducing the risk of moral blind spots in sustainability strategies.

The general public, in turn, may become more aware of underlying value conflicts and feel more empowered to engage thoughtfully with societal decisions. Still, it is important to

recognise that the influence of prior worldviews and cognitive biases means that the effects of such transparency are likely to vary across individuals and contexts. Finally, and arguably most importantly, anyone affected by sustainability decision making, both human and nonhuman, may benefit from decisions that more carefully consider their lived experiences and long-term well-being.

Methodological and conceptual limitations

In each of the literature reviews, including those conducted for the case studies, only a selection of fields and tools most closely related to IE were included within the scope. This was necessary to maintain depth and focus but inevitably limited the breadth. In particular, when examining the implicit use of ethics, only a small number of papers could be analysed, since some form of moral decision making is embedded in all prescriptive sustainability research. While the selected sample was sufficient for the purposes of this project, a broader and more diverse scope could yield more robust and generalisable insights. Additional literature in other languages or databases beyond Google Scholar and the TU Delft Library may also have offered additional perspectives.

The use of AI significantly improved the efficiency and consistency of the literature analysis. It was applied to specific tasks for which large language models are particularly well suited, such as identifying relevant information within large volumes of text and offering feedback on phrasing and word choice. As Chubb et al. (2022) argue, rather than attempting to replicate human intelligence, AI should be used to augment it, not replace it. Nevertheless, the benefits of AI use come with important caveats. Large language models lack full transparency in how they generate responses, may oversimplify complex reasoning, and often reflect embedded biases or express unwarranted confidence in their output.

Despite efforts to cross-check interpretations between myself and the AI tools, some of the moral assumptions identified in the literature may still be incomplete or may not fully capture the original authors' intended views. Ideally, such assumptions would be articulated and clarified by the researchers themselves. As discussed in the Methodology chapter, the ethical theories tentatively linked to assumptions found in the case study literature remain particularly open to interpretation. Many theories overlap and most assumptions could reasonably be associated with multiple ones. While a broad overview was possible, it would be unrealistic to assume that these interpretations always align with the authors' actual ethical positions, particularly if those authors were asked directly. Nevertheless, I believe the results are significantly more comprehensive than they would have been without the support of AI.

One related trade-off concerns the environmental impact of AI use. This introduces an ethical dilemma in itself, as different moral principles may yield different conclusions about its justification. In this case, I personally judged that the benefits of using AI in a focused and intentional way outweighed the associated risks and environmental costs. Still, I recognise that this is an area that warrants continued reflection and research.

Finally, my own interpretive lens may have been subject to confirmation bias when identifying common patterns across the literature. This risk was mitigated by conducting two distinct case studies, applying consistent evaluation criteria across all sources, and using transparent, standardised AI prompts to support the analysis (see Appendix A).

The Delphi study also had some limitations. First, all respondents were affiliated with universities, meaning the perspectives of policymakers, industry professionals, or other stakeholders were not represented. In addition, the survey adapted to the second case study received fewer responses, resulting in less input from that specific perspective. The later rounds also saw a slight drop in participation, limiting the reliability of any analysis of how participants' numerical evaluations evolved between rounds two and three. Finally, some of the arguments in the survey were occasionally misunderstood or interpreted more narrowly than intended. These interpretations were then faithfully reflected in the aggregated summaries, in keeping with the Delphi methodology. For instance, the term "moral foundation" was often taken to mean a single prescriptive ethical theory, rather than what was intended: a shared evaluative ground that enables comparison and dialogue across different ethical theories applied in sustainability research. Many respondents endorsed the value of combining multiple ethical theories to reveal trade-offs, support reflection, and enable constructive debate. Yet the very act of comparing these frameworks presupposes some common evaluative basis. It is this underlying basis, however minimal or procedural, that I originally meant by the term "moral foundation".

Although some debate emerged among Delphi participants regarding the foundational role of experiential information in ethical reasoning, its importance was broadly acknowledged. For the DHMF and HoME Profile to be useful, this recognition is already sufficient. Ultimately, however, the most consistent support for the new framework and tool came from patterns observed in the practical use of ethics within the literature, where (implicit) experiential and outcome-oriented reasoning featured prominently. This also implies that Delphi participants might have formed different views had they been directly exposed to the patterns in this literature themselves. As a result, the Delphi study reflects more of an intuitive expert perspective on the ethical foundations of sustainability research than a fully informed response to the specific findings of this research. Future research involving in-depth interviews could provide a more comprehensive understanding and enable deeper engagement with these observed patterns.

The framework and tool developed in this thesis also come with their own limitations. While the patterns identified across the literature and supported by the Delphi study appear robust, it remains possible that they do not capture the full range of moral perspectives present in sustainability research. Papers outside the 85 analysed in this research may deviate from these patterns. If such exceptions exist, the DHMF and HoME Profile may be less inclusive and less useful for scrutinising that subset of the literature.

As outlined in the previous chapter, the DHMF is designed to serve as a guiding ideal, aspiring to account for the full range of experiential impacts across all sentient beings affected by sustainability-related decisions. While this ideal is inherently unattainable, it offers a consistent and inclusive reference point for evaluating the moral reasoning embedded in sustainability research. Because complete and reliable information about future experiences is impossible to obtain, the framework's strength depends on the quality and transparency of the information available.

The HoME Profile, in turn, faces limitations related to its practical implementation. Multiple versions may need to be developed to accommodate the diversity of publication types in sustainability research, and the instruction manual may also continue to evolve through feedback and iteration. Even with clear guidance, the quality of each HoME Profile will depend

on the researcher's ability and willingness to communicate their reasoning clearly and honestly.

There is also a risk that researchers may use the HoME Profile to present their work in an overly favourable light. This tendency is already present in conventional scientific writing. However, unlike these publications themselves, the HoME Profile makes underlying moral reasoning, and potentially overly optimistic expectations, visible and open to scrutiny. It should therefore be treated not as a guarantee of impartiality, but as a starting point for ethical dialogue. Its potential lies not in eliminating bias, but in making value judgements transparent enough to be questioned, compared, and refined. Although AI tools may support researchers in drafting HoME Profiles, I chose not to explicitly recommend their use due to ongoing ethical debates about their risks and associated environmental impacts.

Opportunities for future research and development

Building on the progress made in this thesis, several directions for future research and cross-sectoral application of the DHMF can be explored. While the HoME Profile represents one practical tool derived from the new framework, other applications are also conceivable. In policymaking, for instance, a DHMF-based tool could support stakeholder mapping by visualising the experiential impacts of proposed policies. In corporate settings, it might enhance sustainability reporting or ethical risk assessments. In education, it could contribute to the development of more accessible materials in sustainability ethics.

The HoME Profile itself would benefit from iterative testing and refinement, ideally through interviews and collaborations with researchers across disciplines. Such efforts could clarify its usability, improve its clarity, and assess its real-world effectiveness in achieving ethical reflection and communication. Taken together, these directions suggest that the DHMF and HoME Profile hold promise as a practical, inclusive, and critically reflective approach to advancing ethically robust decision making, not only in IE, but across the wider field of sustainability research.

5. CONCLUSION

This thesis set out to explore the question of how ethical theories influence research in IE, and how the underlying moral assumptions embedded in such research can be scrutinised more systematically. To address this, the explicit discussion of ethical theories in IE-related literature was mapped. What I found is that there is no single approach to determining what is right or wrong in the context of sustainability. Yet despite the variety of ethical theories applied, the literature consistently justified its assumptions by appealing to futures more desirable for both humans and nonhuman animals than the status quo, effectively using these theories as heuristics.

The same pattern held in papers that did not explicitly address ethics, which was revealed using two case studies: one on green growth versus degrowth, and the other on the anthropogenic impacts on nonhuman animals. These case studies were chosen to reflect two central tensions in IE: economic development versus environmental limits, and human versus nonhuman consideration. In the absence of explicit moral principles, the justifications for the recommendations in these papers became even more clearly rooted in the anticipated outcomes and experiences of those affected.

These findings were presented to a panel of experts in a Delphi study, who interpreted and discussed them from diverse perspectives over three rounds. Despite some differences in interpretation, participants generally acknowledged that this shared evaluative ground, the lived experiences of affected beings, holds promise as a reference point for more transparent and systematic ethical reflection in sustainability research. The study reinforced the relevance of experiential information in ethical reasoning and supported the development of a new descriptive moral framework to complement traditional ethical theories.

Rather than prescribing specific actions from the top down, this new framework clarifies and contextualises moral reasoning from the bottom up, by describing what would actually happen if a certain course of action were taken. Every being capable of experience then becomes a primary moral reference for understanding how their own life would be impacted by the actions researchers recommend. This approach enables a holistic perspective that does not rely on a single ideology, but instead emerges across individuals, communities, and even species; an approach referred to as the Descriptive Holistic Moral Framework (DHMF). Importantly, the framework does not, by itself, prescribe how different experiences should be weighed or which actions should be preferred. Instead, it offers a broad and inclusive structure that *supports* moral decision making.

To translate this framework into practical use, I created the Holistic Moral Evaluation (HoME) Profile. It is designed to support transparency and ethical reflection in IE and related sustainability fields by helping researchers clearly communicate the core message and potential experiential impacts of their work, clarify the moral assumptions behind it, and share these insights with non-specialist audiences. As such, it is not evaluative in itself, but provides the transparency needed for others to carry out a moral evaluation themselves. If adopted and continually refined, the HoME Profile could make the ethical reasoning behind sustainability research more accessible, communicable, and open to critique.

The HoME Profile has the potential to change how scientists, policymakers, and, perhaps most importantly, the general public engage with the science intended to shape our collective future. The knowledge we produce about sustainable development, and the recommendations

that follow from it, should not be hidden behind layers of technical jargon or unspecified assumptions. If we all share responsibility for creating a liveable future, then we must also share responsibility for making the knowledge of how to achieve it accessible to everyone it concerns.

The challenges of sustainability are clearly not merely technical or economic; they are deeply moral. In this century of unprecedented environmental and social change, the integrity of sustainability research will depend on our willingness to question what is right, for whom, and why. This thesis offers researchers a framework and a tool to initiate that conversation more openly. Their strength lies not in the answers they provide, but in the questions they help us ask, so that we are better prepared to find the answers together.

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APPENDIX A: AI PROMPTS FOR PAPER ANALYSIS

Prompt used for literature review

"This is a paper that applies ethics to an Industrial Ecology-related field. I want you to carefully analyse it and identify the ethical theory (or theories) that are discussed in the paper. Then, outline the moral assumptions that follow from this ethical theory. Provide direct quotes from the paper to support your claims, ensuring full transparency. Do not hallucinate. If the ethical framework is not explicitly stated, infer it based on the reasoning and arguments used, and justify your inference with evidence from the text. Also, explore the consequences of the moral assumptions resulting from the ethical theory or theories. If multiple theories are discussed, also mention whether a preference is given for one. Please present your response in a structured format, such as:

1. Ethical Theory Discussed: [Identify and very briefly explain the theory or theories]

2. Moral Assumptions: [List the key underlying moral assumptions that stem from the ethical theory or theories and provide direct quotes from the paper that reveal this]

3. Consequences of Application: [Discuss what consequences the paper's moral assumptions have on its outcomes and recommendations and provide direct quotes from the paper that reveal this]

4. Possible Preference: [If applicable, discuss whether the paper advocates for one ethical theory in favour of others]"

Prompt used for case study 1

"This is a paper that discusses the Industrial Ecology-related field of green growth and/or degrowth. I want you to carefully analyse it and identify the moral assumptions that are being made that are related to green growth and/or degrowth.

After that, determine to which of the following ethical theories each of the moral assumptions belong: Deontology, virtue ethics, social contract theory, utilitarianism, ethical egoism, care ethics (relationship-focused applied ethics), anthropocentrism (human-focused applied ethics), environmental ethics (non-anthropocentric applied ethics, including biocentrism, ecocentrism, pathocentrism, organicism, and deep ecology), religious ethics (faith-focused applied ethics), or distributional ethics (including egalitarianism (focused on equality), prioritarianism (giving priority to the worse off), and sufficientarianism (ensuring a minimum threshold of well-being)).

If the moral assumption doesn't fit any of these theories at all, then explain which alternative one might fit and why.

Also, explore the consequences of the moral assumptions on the outcomes and/or recommendations of the paper.

If the paper takes a holistic, descriptive approach and does not necessarily make any moral assumptions, also let me know.

Always provide direct quotes from the paper to support your claims, ensuring full transparency. Do not hallucinate. Please present your response in a structured format, such as:

1. Paper info: [List the name of the paper and author and whether it ultimately advocates for either green growth, degrowth, or another alternative]

2. Moral Assumptions Made: [List the key underlying moral assumptions that are being made and the ethical theory that is implicitly being applied, including a very brief clarification. Provide direct quotes from the paper that you base your claims on]

3. Consequences of Application: [Discuss what consequences the paper's moral assumptions have on its outcomes and/or recommendations and provide direct quotes from the paper that reveal this]"

Prompt used for case study 2

"This is a paper that discusses animals in Industrial Ecology or Industrial Ecology-related fields and tools. I want you to carefully analyse it and identify the moral assumptions that are being made that concern nonhuman animals.

After that, determine to which of the following ethical theories each of the moral assumptions belong: Deontology, virtue ethics, social contract theory, utilitarianism, ethical egoism, care ethics (relationship-focused applied ethics), anthropocentrism (human-focused applied ethics), environmental ethics (non-anthropocentric applied ethics, including biocentrism, ecocentrism, pathocentrism, organicism, and deep ecology), religious ethics (faith-focused applied ethics), or distributional ethics (including egalitarianism (focused on equality), prioritarianism (giving priority to the worse off), and sufficientarianism (ensuring a minimum threshold of well-being)).

If the moral assumption doesn't fit any of the theories at all, then explain which alternative one might fit and why.

Also, explore the consequences of the moral assumptions on the outcomes and/or recommendations of the paper.

If the paper takes a holistic, descriptive approach and does not necessarily make any moral assumptions, also let me know.

Always provide direct quotes from the paper to support your claims, ensuring full transparency. Do not hallucinate. Please present your response in a structured format, such as:

1. Paper info: [List the name of the paper and author and in what way it discusses nonhuman animals]

2. Moral Assumptions Made: [List the key underlying moral assumptions that are being made and the ethical theory that is implicitly being applied, including a very brief clarification. Provide direct quotes from the paper that you base your claims on]

3. Consequences of Application: [Discuss what consequences the paper's moral assumptions have on its outcomes and/or recommendations and provide direct quotes from the paper that reveal this]"

APPENDIX B: TEMPLATE INVITATION EMAIL DELPHI STUDY

Dear [*name of expert*],

My name is Stuart Kordes and I'm currently conducting a thesis project on the **ethical foundations of sustainability research** as part of my master's degree in Industrial Ecology at Delft University of Technology and Leiden University. In my thesis, I examine how ethical theories are applied both explicitly and implicitly in sustainability research, and how the resulting moral assumptions influence research outcomes and policy recommendations.
As part of this work, I'm carrying out a **Delphi study** to gather expert insights from a range of stakeholders involved in sustainability-related decision making. Given your expertise in [*expert's expertise*], I believe your perspective would be a valuable contribution. If you don't have time to participate yourself, feel free to forward this email to someone you believe could also offer a valuable perspective.

The study involves **three rounds of anonymous online surveys**. In the first round, you're asked for your professional opinion on the ethical underpinnings of sustainability research through a series of open questions. Completing this should take approximately **15 to 40 minutes**, depending on the level of detail you wish to include in your responses. In the second and third rounds, you'll receive the same questions again, this time accompanied by a summary of the combined responses to each question from all participants in the previous round. This aggregated overview gives you an opportunity to reflect on the wider range of perspectives and reconsider or expand on your earlier answers.

Based on your background, you would receive the version of the survey adapted to the [first/second] case study I conducted: [***the debate on green growth vs degrowth*** *OR* ***discussions of the anthropogenic impacts on nonhuman animals***]. If you would prefer the version adapted for the other case study ([*discussions of the anthropogenic impacts on nonhuman animals OR the debate on green growth vs degrowth*]), that is also possible.

Would you be willing to take part in this study?

If so, I would be grateful if you could review and sign the attached **informed consent form**. Once I've received it, I will send you the survey link for the first round within two days. The survey will remain open until **25 April 2025**. Around one week later you will receive the survey for the second round.

Thank you very much for your time and consideration. Please don't hesitate to reach out if you have any questions.

Kind regards,
Stuart Kordes

APPENDIX C: TABLES FROM LITERATURE REVIEW

Table C1: Overview of the ethical theories, moral assumptions, and outcomes and recommendations of each paper explicitly discussing ethics and IE.

Paper	Ethical Theory/ Theories Discussed	Main Moral Assumptions	Impact on Outcomes/ Recommendations
Boons & Roome (2000)	*Holistic view of **normative ethics** in general (descriptive).*	Scientific inquiry is inherently normative. Discourse about normative issues is essential for IE to shape society.	The authors advocate that IE's scope should be broader and its approach more practical, reflexive, and inclusive.
Heide & Gjerris (2024)	**Sufficientarianism** (principle-based), **grandfathering** (precedent-focused principle), **egalitarianism** (principle-based), **prioritarianism** (principle-based and outcome-based), and **utilitarianism** (outcome-based).	Basic human needs must be met before considering further distributive concerns. Human rights define minimum welfare standards. Ethical values must be explicit and transparent in sustainability models to avoid being dictated by what is quantifiable.	The authors advocate sufficientarianism for Absolute Environmental Sustainability Assessments, provided that certain ethical premises are accepted (see moral assumptions).
Hjalsted et al. (2021)	**Egalitarianism** (principle-based), **prioritarianism** (principle-based and outcome-based), **grandfathering** (precedent-focused principle), and **anthropocentrism** (human-focused applied ethics).	Anthropocentrism is the basis for moral allocation principles related to climate change and biogeochemical flows. Any individual has the same right to the safe operating space within the planetary boundaries.	The authors conclude that resource allocation should be human-centred and that equal per capita allocation is a strong guiding principle.
Keitsch (2011)	**Anthropocentrism** (human-focused applied ethics) supplemented by **moderate biocentrism** (non-anthropocentric applied ethics).	Every life has a value in itself. Principles such as responsibility, openness, and correspondence are important in IE research.	The author concludes that moderate biocentrism should supplement the anthropocentric positions of IE for a more balanced approach.
Oyewole (2001)	**Social contract theory** (principle-based), **integrative social contracts theory** (business-focused applied ethics), **teleological ethics** (outcome-based), and **deontology** (principle-based).	Corporations must enhance the welfare of society. Fairness in environmental impact distribution is a moral duty. Environmental justice in the practice of green marketing is a social contract.	The author argues that consumers will and should bear the costs of achieving environmental justice in the practice of green marketing.

Table C2: Overview of the ethical theories, moral assumptions, and outcomes and recommendations of each paper explicitly discussing ethics in IE-related fields.

Paper	Ethical Theory/ Theories Discussed	Main Moral Assumptions	Impact on Outcomes/ Recommendations
Alam et al. (2025)	*A psychological framework is discussed instead of an ethical theory: **Value-belief-norm theory** (environmental principle-based psychological framework).*	Individuals must prioritise societal and ecological benefits over personal convenience. Biospheric values, such as environmental preservation and resource conservation, lead to sustainable choices.	The authors argue that marketing strategies should align with consumers' ethical and environmental values. By addressing key psychological and practical barriers, we can enhance consumer acceptance, advance sustainability goals, and promote the CE.
Ashton et al. (2022)	*Discussion of different types of **justice**: distributive, procedural, and interactional (principle-based applied ethics).*	Justice requires recognition of local knowledge and participation in CE policymaking. Sustainability must account for social equity and fairness.	The authors argue that the CE, like other sustainability models, remains rooted in growth-oriented ideology, neglecting socio-cultural disparities and excluding marginalised groups, such as informal waste workers, from policy-making. Its optimistic rhetoric is undermined by an overemphasis on technological and economic solutions.
Auxtova et al. (2024)	**Virtue ethics** (principle-based).	Virtuous behaviour is a process that develops over time and not through rules or by maximising utility. Sustainability is a virtue.	The authors argue virtuous behaviour in second-hand shopping emerges from dynamic, emotion-driven choices rather than fixed identities. Instead of focusing on who consumes sustainably, we should examine how consumers navigate the emotional and practical processes that shape their decisions.
Clingerman (2024)	**Christian theological ethics** (faith-focused applied ethics) with elements of **virtue ethics** (principle-based).	Humanity has an ethical responsibility to act within planetary boundaries. Qualified or constrained hope results in a balanced motivation for action.	The author argues that climate and sustainability research should integrate theology and ethics to enrich moral narratives, critiques precautionary ethics for being overly risk-averse and lacking transformative vision, and advocates for hope as a crucial ethical tool linked to political and social change.
Drake & Schlachter (2008)	**Virtue ethics** (principle-based) and **utilitarianism** (outcome-based).	Moral character matters in business. Means matter, not just ends. Trust, fairness, reciprocity, and cooperation are important virtues.	The authors conclude that dictatorial collaboration undermines trust and long-term success, whereas virtuous collaboration strengthens competitive advantage. They argue that utilitarian approaches may overlook ethical shortcomings, emphasising that

Paper	Ethical Theory/ Theories Discussed	Main Moral Assumptions	Impact on Outcomes/ Recommendations
		True collaboration must consider the interests of all parties.	businesses must balance self-interest with ethical responsibilities to encourage sustainable partnerships.
Gunawardhana (2024)	**Utilitarianism** (outcome-based), **care ethics** (relationship-focused applied ethics) and **deontology/Kantian ethics** (principle-based) supported by **non-epistemic values** (principle-based).	Moral responsibility extends beyond outcomes to processes, meaning our decision making must include Kantian ethics. The well-being of workers and marginalised communities must be prioritised. Non-epistemic values, such as social justice and fairness, must be integral to sustainability metrics.	The author argues that a balanced ethical approach to sustainability and the CE should integrate deontological principles and care ethics alongside mere utilitarian logic. CE policies worldwide must make ethical considerations a mandatory component, ensuring that indicators are redesigned to incorporate ethical factors into their assessment.
Hatami et al. (2024)	**Care ethics** (relationship-focused applied ethics).	Moral responsibility is relational and forward-looking. Moral decision making must be contextual and based around interdependence and relationships. Humans have an obligation to care for the Earth. Ethics should extend beyond humans to include nonhuman life.	The authors argue that care ethics provides a strong foundation for the CE as a business model for environmental well-being, promoting mutual care, empathy, and peaceful coexistence over domination and exploitation.
Karimova & LeMay (2024)	*Holistic view of* **utilitarianism** *(outcome-based),* **deontology** *(principle-based), and* **virtue ethics/Aristotelian ethics** *(principle-based) (descriptive).*	Ethical standards need widespread acceptance. Ethical supply chains require cross-cultural engagement. Circularity is inherently an ethical standard.	The authors argue that the success of the CE and circular supply chains requires normative alignment while balancing trade-offs between moral principles and economic realities.
Kortetmäki et al. (2023)	**Ecocentrism** (ecosystem-focused applied ethics), **deep ecology** (life-focused applied ethics), and **non-anthropocentrism** (applied ethics).	Well-being is not limited to humans but extends to ecosystems and nonhuman life. Moral value is grounded in the self-regenerative capacity of living entities. Moral obligations must consider systemic integrity rather than just individual well-being.	The authors argue that our primary duties to larger ecological and evolutionary processes for planetary well-being should include both negative duties (avoiding harm) and positive duties (restoration and protection of ecosystems).
Morseletto (2022)	*Discussion of principles in general (sustainability-focused* **deontology** *with outcome-based elements).*	The seven principles of (1) no harm to nature, (2) maintaining the health of ecosystems, (3) minimising environmental damage, (4) restoring/ remediating damage, (5) no net	The author argues efficiency principles alone are insufficient for sustainability in the CE, as they can sometimes increase environmental impacts. Sustainable economic

Paper	Ethical Theory/ Theories Discussed	Main Moral Assumptions	Impact on Outcomes/ Recommendations
		loss, (6) net positive impact/net gain, and (7) continual environmental improvement.	frameworks must adopt a long-term vision for nature conservation, ensuring ecosystem health and carefully applying no net loss and net-positive principles to support urgent natural system rehabilitation.
Nilsen (2024)	**Utilitarianism** (outcome-based), **virtue ethics** (principle-based), **ecofeminism** (gender-focused environmental applied ethics), **ecocentrism** (ecosystem-focused applied ethics), and **organicism** (universe-focused applied ethics).	Biophysical thresholds are non-negotiable realities that must be respected. Voluntary business ethics is insufficient to address the ecological crisis. Utilitarian economics is flawed with regards to encroaching ecological thresholds.	The author argues that strong legal regulations and compliance are essential to staying within ecological thresholds, as voluntary ethical theories alone (whether ecofeminist, organic, or others) are unlikely to drive sufficient change within a system still dominated by utilitarian economics. To avoid ethical discussions becoming detached from urgent realities, interdisciplinary collaboration in sustainability research and education is crucial.
Oldak (2023)	**Christian business ethics** (faith-focused applied ethics).	We have universal moral obligations based on scriptural principles. Honesty, trust, and integrity should be the foundation of all sustainable business dealings. We have a moral obligation to pay just wages.	The author argues that we should aim for collaborative supply chains, competitive advantages, and fair decision making, rewards, and communication in supply chain management, while avoiding becoming overly entangled or attached to the relationships.
Palm et al. (2024)	**Care ethics** (relationship-focused applied ethics).	Care work is morally significant and undervalued in mainstream economic models. Social and environmental justice are inseparable. Radical societal changes are required so care labour becomes more visible and justly distributed.	The authors argue that gendered inequalities in the CE should be addressed, advocating for policies that consider labour distribution and decision-making power rather than solely focusing on resource efficiency. This is essential to encouraging innovation, sustainability, and social justice within CE initiatives.
Paulraj et al. (2015)	*Holistic view of **deontology** (principle-based), **virtue ethics** (principle-based), **utilitarianism** (outcome-based), and **ethical egoism** (outcome-based) (descriptive).*	With utility as the sole moral good, a conflict may arise with that of justice.	The study found that many firms adopt sustainable supply-chain management based on moral duty (deontology) or intrinsic moral character (virtue ethics), rather than self-interest (ethical egoism) or purely instrumental benefits.

Paper	Ethical Theory/ Theories Discussed	Main Moral Assumptions	Impact on Outcomes/ Recommendations
Pla-Julián & Guevara (2019)	**Care ethics** (relationship-focused applied ethics).	Sustainability must prioritise care for people and the environment. A world organised to care well requires a focus on politics, particularity and plurality, and purposiveness. Gender and social justice are inseparable from sustainability.	The authors advocate for a more inclusive, relational, and context-sensitive approach to sustainability. They argue that the CE should be more equitable, integrating social and gender dimensions. Policies should shift from prioritising economic growth to developing new success indicators, including those that capture social change and well-being.
Qiao & Qiao (2013)	**Environmental ethics** (non-anthropocentric applied ethics) with elements of **justice** (principle-based).	Economic development should be subordinate to ecological constraints. Moral responsibility extends beyond individual companies to collective economic structures. Intergenerational justice must be upheld. The economy should prioritise qualitative, not just quantitative, growth.	The authors advocate for a shift from isolated corporate responsibility to a cooperative, system-wide approach, emphasising that CE consumption embodies sustainable value principles. This integration of economic, ecological, and moral values promotes a balanced and enduring relationship between economy, society, and the environment.
Sergejeva (2023)	*Holistic view of the interplay between* **utilitarianism** *(outcome-based) and* **deontology** *(principle-based) in EU's Green Deal (descriptive).*	*The moral assumptions underlying the Green Deal are explicitly discussed in the paper itself, emphasising the role of the state, the moral agency of individuals, and the value of nature as either instrumental or intrinsic (descriptive).*	The author concludes that the Green Deal is primarily deontological but retains utilitarian elements in economic policies. While economic growth remains central, the policy's justice-based principles reflect a stronger deontological influence. However, tensions between market-driven utilitarianism and deontological regulation remain unresolved, particularly in balancing economic efficiency with environmental and social obligations.
Tukiran et al. (2023)	**Utilitarianism** (outcome-based)	What is morally justifiable is the action or rule that is expected to best promote the greatest happiness or benefit for the most people.	The authors conclude that applying utilitarian ethics in a circular economy can maximise benefits for a broad range of stakeholders, including entrepreneurs, consumers, and society as a whole, leading to significant economic, social, and environmental advantages. However, they also acknowledge the potential for inequality, particularly for small

Paper	Ethical Theory/ Theories Discussed	Main Moral Assumptions	Impact on Outcomes/ Recommendations
			communities, and emphasise the need for an inclusive and fair implementation of circular economy practices.
Zorpas et al. (2024)	**(Christian and Islamic) Environmental ethics** (non-anthropocentric applied ethics).	All forms of life have an inherent worth beyond their utility to humans. Environmental responsibility extends to future generations. Ethical consumption means choosing products that benefit both oneself and the broader environment and society.	The authors argue that economic activities should be structured to minimise harm and support sustainability goals, with environmental ethics guiding policies and industrial strategies, emphasising the need to design products with their entire lifecycle in mind while advocating for ethical technological innovation to promote circularity within the CE.

Table C3: Overview of the ethical theories, moral assumptions, and outcomes and recommendations of each paper explicitly discussing ethics in IE-related tools.

Paper	Ethical Theory/ Theories Discussed	Main Moral Assumptions	Impact on Outcomes/ Recommendations
Birat (2019)	*Holistic view of* **anthropocentrism** *(human-focused applied ethics),* **biocentrism** *(non-anthropocentric applied ethics),* **ecocentrism** *(ecosystem-focused applied ethics),* **consequentialism** *(outcome-based),* **deontology** *(principle-based), and* **virtue ethics** *(principle-based) (descriptive).*	It might be necessary to shift from anthropocentrism to ecocentrism.	The author critiques the anthropocentric bias in environmental policies and emphasises the need for ethical integration that connects human activities with nature. Scientists and engineers must move beyond disciplinary isolation, embracing interdisciplinary cooperation to address environmental challenges effectively.
Brander et al. (2019)	*Holistic view of* **deontology** *(principle-based) and* **consequentialism** *(outcome-based) (descriptive).*	Consequentialism alone is not sufficient for environmental responsibility; an attributional (deontological) approach is also necessary to define responsibility.	The authors argue that attributional LCA and consequential LCA should be used together in a 'coupled accounting' approach to ensure both responsibility and effective decision making.
Ekvall et al. (2005)	*Holistic view of* **teleological ethics** *(outcome-based) and* **deontology** *(principle-based) (descriptive).*	Retrospective LCA aligns with deontological and teleological rule-based ethics. Prospective LCA aligns with teleological situation ethics.	The authors argue that both retrospective and prospective LCA have methodological limitations and ethical drawbacks, potentially leading to unfair assessments. As a result, applying both methodologies together may sometimes be necessary to ensure a more balanced evaluation.

Paper	Ethical Theory/ Theories Discussed	Main Moral Assumptions	Impact on Outcomes/ Recommendations
Finnveden (1997)	*Holistic view of **utilitarianism/ teleological ethics** (outcome-based) and **deontology** (principle-based) (descriptive).*	Environmental justice is often overlooked in LCA valuation methods.	The author argues that market-based valuation methods may reinforce economic inequalities by prioritising market-derived values, while discounting future impacts implicitly devalues future generations, potentially justifying unsustainable practices. To ensure a fair and transparent decision-making process, ethical assumptions in valuation methods must be made explicit.
Freidberg (2018)	*Holistic view of **values** and scientific objectivity in general (principle-based) (descriptive).*	Value neutrality in LCA is not possible. Public trust and emotional engagement are essential in decision making.	The author advocates for greater transparency and reflexivity in LCA, urging practitioners to challenge traditional scientific norms (such as ISO 14040) and to critically engage with corporate and governmental sustainability claims.
Schiller (2009)	**Discourse ethics** (communication-focused procedural ethics).	Norms in MFA should be justified through rational discourse rather than imposed by economic or political power. Decision making must accommodate uncertainty and ambiguity.	The author rejects purely market-based solutions to environmental problems in favour of interdisciplinarity and institutional reforms that incorporate discourse ethics.
Steen (2006)	*Holistic view of **utilitarianism** (outcome-based), **anthropocentrism** (human-focused applied ethics), **pathocentrism** (sensation-focused applied ethics), **biocentrism** (non-anthropocentric applied ethics), **holism** (system-focused applied ethics), and **justice** (principle-based) (descriptive).*	LCA requires ethical justification to ensure transparency and legitimacy in decision making.	The author emphasises that the choice of weighting method shapes conclusions, directly influencing sustainability-driven policy recommendations. Greater transparency in ethical assumptions enhances the effectiveness of LCA decision making by clarifying value-based trade-offs.
Weidema & Brandão (2015)	**Utilitarianism** (outcome-based) and **rule-based ethics** (principle-based).	Ethical and political choices in life cycle impact assessments and sustainability should not be misrepresented as science.	The authors present planetary boundaries as unnecessarily restrictive and advocate for a utilitarian, damage-based approach.

APPENDIX D: TABLES FROM CASE STUDIES

Case Study 1

Table D1: Overview of the stance of each analysed paper in the green growth vs degrowth debate and the best-fitting implicit ethical theories that are applied in each of them.

Paper	Advocating for	Best-Fitting Implicit Ethical Theories
Belmonte-Ureña et al. (2021)	*Neutral*	*Holistic view: green growth tends to rely on anthropocentrism and utilitarianism, and degrowth tends to rely on environmental ethics and distributional ethics (descriptive)*
Büchs & Koch (2019)	Degrowth	Distributional ethics, environmental ethics, utilitarianism
Cosme et al. (2017)	Degrowth	Environmental ethics, utilitarianism, distributional ethics, care ethics, social contract theory
Desalegn & Tangl (2022)	Green growth	Anthropocentrism, utilitarianism, distributional ethics, deontology
Dunlap & Laratte (2022)	Degrowth	Distributional ethics, social contract theory, environmental ethics
D'Alessandro et al. (2020)	Degrowth	Utilitarianism, distributional ethics, environmental ethics, social contract theory, care ethics
Fitzpatrick et al. (2022)	Degrowth	Environmental ethics, distributional ethics, care ethics, social contract theory
Gerber (2020)	Degrowth	Environmental ethics, distributional ethics, virtue ethics, social contract theory
Hanaček et al. (2020)	Degrowth	Environmental ethics, distributional ethics, care ethics
Hickel & Kallis (2020)	Degrowth	Environmental ethics, distributional ethics, utilitarianism
Kallis (2017)	Degrowth	Environmental ethics, distributional ethics, utilitarianism
Kallis et al. (2012)	Degrowth	Utilitarianism, environmental ethics, distributional ethics
Kallis et al. (2018)	Degrowth	Utilitarianism, environmental ethics, distributional ethics, social contract theory
Kallis et al. (2023)	*Neutral*	*Holistic view: assumptions in green growth and degrowth span environmental ethics, care ethics, distributional ethics, anthropocentrism, and utilitarianism (descriptive)*
Kallis & March (2015)	Degrowth	Environmental ethics, social contract theory, virtue ethics, care ethics
Kothari et al. (2014)	Degrowth (and Ecological Swaraj, Buen Vivir)	Environmental ethics, distributional ethics, care ethics, social contract theory, virtue ethics, religious ethics
Lang (2024)	Decolonial post-growth (not strict degrowth)	Social contract theory, distributional ethics, environmental ethics, care ethics
Lorek & Spangenberg (2014)	Degrowth	Environmental ethics, distributional ethics, care ethics, social contract theory
Mastini et al. (2021)	Degrowth	Distributional ethics, environmental ethics
Murshed (2024)	Green growth	Anthropocentrism, utilitarianism, social contract theory, distributional ethics
Ossewaarde & Ossewaarde-Lowtoo (2020)	*Neutral*	*Holistic view: EU's Green Deal is primarily rooted in anthropocentrism and utilitarianism (descriptive)*
Polewsky et al. (2024)	*Neutral*	*Holistic view: assumptions from environmental ethics and distributional ethics are more common in degrowth*

Paper	Advocating for	Best-Fitting Implicit Ethical Theories
		research, whereas green growth largely avoids questioning its own theoretical foundations (descriptive)
Sandberg et al. (2019)	Degrowth	Environmental ethics
Savin & van den Bergh (2024)	*Neutral*	*Holistic view: literature on degrowth seems to be dominated by policy advice stemming mainly from environmental ethics and distributional ethics (descriptive)*
Savini (2024)	Degrowth	Utilitarianism, care ethics, distributional ethics, environmental ethics
Schneider et al. (2010)	Degrowth	Utilitarianism, environmental ethics, distributional ethics, care ethics, virtue ethics
Stoknes & Rockström (2018)	Green growth	Utilitarianism, anthropocentrism, environmental ethics, distributional ethics
Sun et al. (2020)	Green growth	Utilitarianism, anthropocentrism, distributional ethics, technological optimism
Van den Bergh (2011)	A-growth	Utilitarianism, environmental ethics, social contract theory

Table D2: Overview of the moral assumptions made in the analysed papers on green growth and degrowth and their impact on the outcomes and recommendations.

Paper	Citations	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/ Recommendations
Belmonte-Ureña et al. (2021)	360	*The paper makes few prescriptive claims but instead takes a holistic approach by analysing the (moral) assumptions embedded in CE, degrowth, green growth, and SDG research and whether they align with the UN Sustainable Development Agenda 2030. Green growth tends to rely on* **anthropocentrism** *and* **utilitarianism**, *and degrowth tends to rely on* **environmental ethics** *and* **distributional ethics** *(descriptive).*	The authors argue that green growth has strong policy influence but relies on technological fixes over systemic change. Degrowth, though controversial, is gaining traction. The CE appeals to policymakers for efficiency but struggles with its link to growth. The SDGs shape sustainability research by evaluating how these paradigms align with global goals.
Büchs & Koch (2019)	320	We have an obligation to satisfy the basic needs of future generations (**distributional ethics**). Alternatives to economic growth need to be pursued both to stop climate change and to achieve well-being (**environmental ethics** and **utilitarianism**).	The authors advocate redefining well-being beyond GDP and promoting sustainable lifestyles but acknowledge structural resistance to degrowth and potential short-term well-being losses. They argue that a transition could ultimately enhance well-being through less materialistic values and propose cultural transformation and new political mechanisms, such as deliberative forums and democratic decision making that account for future generations' needs.
Cosme et al. (2017)	454	Human activities should be limited to reduce environmental impact (**environmental ethics**). Economic growth should not be prioritised for well-being (**utilitarianism**).	The authors present degrowth as a solution to sustainability challenges, emphasising social equity and ecological sustainability. Since degrowth proposals can be complementary, conflicting, or

Paper	Citations	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/ Recommendations
		Redistribution of wealth and income is necessary (**distributional ethics**). The transition to a convivial and participatory society should be promoted (**care ethics** and **social contract theory**).	redundant, careful analysis is required to determine their policy feasibility and the order in which they should be implemented.
Desalegn & Tangl (2022)	104	Economic growth is a necessity for sustainability (**anthropocentrism** and **utilitarianism**). Green growth should be structured to prevent disproportionate harm to disadvantaged groups (**distributional ethics**). Governments should play a central role (i.e., have a duty) in encouraging green finance (**deontology**).	The authors assume economic growth is necessary, rejecting degrowth perspectives. They advocate market-based solutions, such as green bonds and green credit, to address the financing gap while emphasising the role of government regulation. Additionally, they stress that green growth policies should be carefully designed to prevent irreversible harm to vulnerable communities.
Dunlap & Laratte (2022)	131	Green growth is a continuation of capitalist exploitation and structural injustice (**distributional ethics** and **social contract theory**). We should prioritise nonhuman existences over (industrial) human desires for capitalist convenience and techno-infrastructural progress (**environmental ethics**).	The authors argue that green growth, large-scale renewable energy infrastructures, and mainstream energy transition policies perpetuate extractivism and socio-ecological harm. Instead, they advocate for a degrowth approach that reduces energy demand, prioritises social and ecological well-being over economic expansion, and decentralises energy governance to ensure more just and sustainable outcomes.
D'Alessandro et al. (2020)	343	Economic growth should not be prioritised over social and environmental well-being (**utilitarianism**, **distributional ethics**, and **environmental ethics**). Social policies should be used to counteract inequality and market failures (**distributional ethics** and **social contract theory**). Unemployment must be addressed (**care ethics**). Ecological limits must be respected, and economic policy should align with planetary boundaries (**environmental ethics**).	The authors critique green growth and dismiss market-based environmental solutions as insufficient. Instead, they favour policies for social equity and degrowth, advocating for redistributive measures, progressive taxation (e.g., wealth tax), working time reductions, consumption reductions, and job guarantee programmes as more effective strategies for achieving both social and environmental goals.
Fitzpatrick et al. (2022)	221	Consumption and production must be reduced (**environmental ethics**). Equality and redistribution are necessary (**distributional ethics**).	The authors advocate for degrowth as a planned and democratic reduction of production and consumption to address social-ecological crises. By compiling a comprehensive inventory of

Paper	Citations	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/ Recommendations
		Work should be reduced and restructured (**care ethics**). Decision making should be decentralised and democratised (**social contract theory**). Wealth accumulation and private property rights should be curtailed (**distributional ethics**).	degrowth policy proposals, they provide a structured overview of the field, facilitating critical reflection on the coherence, feasibility, and strategic implications of the degrowth discourse.
Gerber (2020)	116	The ideology of economic growth is fundamentally flawed and serves as a mechanism of class pacification, economic inequality, and ecological destruction (**environmental ethics** and **distributional ethics**). A radical downscaling of economic throughput and redistribution of land is required to avoid environmental degradation and social inequity (**environmental ethics** and **distributional ethics**). Decentralised, small-scale economic models are needed that embrace limits, cooperation, decentralisation, autonomy, friendship and beauty (**virtue ethics** and **social contract theory**).	The author argues that green growth and technological innovation alone are insufficient solutions unless they address structural issues of consumption and inequality. Instead, they advocate for small-scale, localised economies and support social and environmental movements as essential pathways towards a just and sustainable future.
Hanaček et al. (2020)	113	Economic growth is unsustainable due to environmental limits and inequality (**environmental ethics** and **distributional ethics**). The Global North should degrow so the Global South can develop (**environmental ethics** and **distributional ethics**). Women's unpaid labour (e.g., care work) is undervalued and essential for sustainable societies (**care ethics** and **distributional ethics**).	The authors argue that economic growth is fundamentally problematic and advocate for degrowth in the Global North as a form of responsibility. They promote alternative economic models, such as solidarity economies and "Buen Vivir", a reconfiguration of care systems to reduce resource use and distribute labour more equitably, and greater support for feminist, indigenous, and environmental justice movements.
Hickel & Kallis (2020)	2286	We must avoid ecological collapse and stay within planetary boundaries (**environmental ethics**). Economic growth should not be pursued at the expense of ecological and social stability and equality (**environmental ethics**, **distributional ethics**, and **utilitarianism**).	The authors conclude that green growth should be abandoned as a policy objective, as it lacks empirical support. Instead, they suggest that degrowth may be necessary to achieve ecological sustainability. While acknowledging the political challenges, they argue that policy-driven solutions must take precedence, even if what is

Paper	Citations	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/ Recommendations
			ecologically necessary is currently seen as politically unfeasible.
Kallis (2017)	198	Continued growth despite ecological limits is unacceptable (**environmental ethics**). Work and resources should be distributed more fairly (**distributional ethics**). Capitalist structures should not prioritise profit over ecological and social well-being (**environmental ethics** and **utilitarianism**).	The author advocates for degrowth, work-sharing, and equity-focused policies, rejecting the assumption that growth is necessary for well-being. Achieving these goals requires a radical reconfiguration of economic and political power to prioritise sustainability and fairness over capitalist profit-driven demands.
Kallis et al. (2012)	960	Economic growth beyond satisfying basic needs does not necessarily improve well-being and has more costs than benefits, particularly environmental ones (**utilitarianism** and **environmental ethics**). Degrowth should be pursued in a way that ensures social equity, preventing the burden from falling on the most vulnerable (**distributional ethics**).	The authors call for a shift from GDP growth to well-being metrics, arguing that capitalist economies are structurally dependent on growth and cannot voluntarily degrow without systemic change.
Kallis et al. (2018)	894	Well-being and prosperity do not depend on high levels of production and consumption (**utilitarianism** and **environmental ethics**). A just society requires redistribution, not growth (**distributional ethics**). Economic growth is a driver of social inequality (**distributional ethics**). Democracy is compatible with degrowth but requires institutional changes (**social contract theory**).	The authors reject green growth in favour of systemic change in the form of degrowth, advocating for economic models that prioritise redistribution over expansion. They call for new governance structures and policies, including reduced working hours, a shift away from shareholder-based firms, and greater emphasis on labour-intensive sectors.
Kallis et al. (2023)	21	*The paper makes few prescriptive claims but instead describes political positions and (moral) assumptions on green growth and degrowth. These assumptions span* **environmental ethics**, **care ethics**, **distributional ethics**, **anthropocentrism**, *and* **utilitarianism** *(descriptive).*	The authors found that degrowth remains politically marginal despite academic and activist support, while green growth is predominantly a centre-right position rather than a universal compromise. However, leftist coalitions could unite around shared priorities such as public investment, environmental justice, and work-time reductions.
Kallis & March (2015)	306	Growth is not an intrinsic good, and self-limitation is necessary for a just and sustainable society (**environmental ethics** and **virtue ethics**).	The authors argue that achieving a non-capitalist society requires radical socioecological transformation rather than reform, emphasising activism, nonviolent resistance, and local self-sufficiency. They advocate for

Paper	Citations	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/ Recommendations
		Localised, decentralised economies are preferable to global capitalist structures (**social contract theory**). Nonviolent resistance is necessary to challenge a capitalist system that cannot do without growth (**care ethics** and **social contract theory**).	collective self-limitation through shared commons, which they see as key to dissolving scarcity and encouraging an alternative economic system based on egalitarian, non-capitalist principles.
Kothari et al. (2014)	625	Radical redistribution is necessary for global justice and sustainability (**distributional ethics**). Community self-governance is superior to centralised state and corporate control (**social contract theory** and **virtue ethics**). Nature has intrinsic value beyond human use (**environmental ethics**). Indigenous knowledge and spiritual worldviews must be valued (**care ethics** and **religious ethics**).	The authors reject market-based environmental solutions and globalised capitalism, arguing that green growth and sustainable development are inadequate responses. Instead, they advocate for decentralised, community-based economies. They call for a moral and spiritual reconnection with nature and promote degrowth, alongside the concepts of "Buen Vivir" and "Ecological Swaraj", as alternatives to economic expansion.
Lang (2024)	7	The global economic system is structurally unjust, requiring decolonial reform (**social contract theory** and **distributional ethics**). Decolonial perspectives should guide sustainable modes of living (**environmental ethics** and **care ethics**).	The author rejects GDP growth as a policy goal, advocating redistribution and structural reforms to address global injustices. They call for transforming governance to dismantle neo-colonial green growth. Instead of universal degrowth, they propose limiting extractivism and elite overconsumption while encouraging locally-driven, ecologically sustainable, and socially just development models.
Lorek & Spangenberg (2014)	950	Future generations, the world's poor, and environmental limits should be respected (**distributional ethics** and **environmental ethics**). Affluent consumers must significantly reduce resource consumption (**distributional ethics**). Civil society must lead systemic change (**care ethics** and **social contract theory**).	The authors critique green growth and advocate for degrowth and redistribution, arguing that affluent consumers must significantly reduce resource consumption. They emphasise the importance of institutional change and the role of civil society (particularly NGOs) in pushing for political transformation.
Mastini et al. (2021)	425	Economic growth should not be a societal goal (**distributional ethics** and **environmental ethics**). The Green New Deal should focus on redistribution and taxation (**distributional ethics**).	The authors reject green growth and market-based environmental policies, advocating for strong government intervention through universal basic services, job guarantees, and the reallocation of funds from socially and

Paper	Citations	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/ Recommendations
			environmentally harmful sectors to sustainability initiatives.
Murshed (2024)	31	Economic growth should continue in a greener way (**anthropocentrism** and **utilitarianism**). Good governance is a necessary mediator for green growth (**social contract theory** and **distributional ethics**).	The author concludes that a renewable energy transition alone is insufficient to achieve green growth without simultaneous improvements in governance. They argue that effective governance, rather than market forces alone, is essential for addressing environmental externalities. Rather than advocating for a reduction in economic activity (degrowth), the author assumes that economic growth can be made environmentally sustainable through targeted policy interventions.
Ossewaarde & Ossewaarde-Lowtoo (2020)	139	*The paper makes few prescriptive claims but instead takes a holistic approach by analysing the (moral) assumptions embedded in the EU's Green Deal itself, which are primarily rooted in* **anthropocentrism** *and* **utilitarianism** *(descriptive).*	The author concludes that the Green Deal fails to address the underlying inequalities in environmental impact and economic power. Instead, it remains rooted in a conventional industrial model, relying on green technology without challenging existing power structures.
Polewsky et al. (2024)	18	*The paper makes few prescriptive claims but instead compares the (moral) assumptions underlying degrowth and green growth. It reveals that assumptions from* **environmental ethics** *and* **distributional ethics** *are more common in degrowth research, whereas green growth largely avoids questioning its own theoretical foundations, relying instead on policy-driven, market-based approaches (descriptive).*	The authors emphasise the need for greater interdisciplinary dialogue between green growth and degrowth research. They recommend encouraging collaboration to address blind spots, synthesising insights on social change and transition, and developing a more integrated research agenda that balances top-down policy approaches with bottom-up activism.
Sandberg et al. (2019)	296	Humanity must decrease its impact on the natural environment (**environmental ethics**). Green growth is problematic because it prioritises economic growth over environmental preservation (**environmental ethics**).	The authors argue that degrowth has a stronger normative foundation than green growth, primarily because it prioritises environmental preservation, social equity, and well-being over economic growth.
Savin & van den Bergh (2024)	8	*The paper makes few prescriptive claims but instead evaluates the academic discourse and (moral) assumptions of literature on degrowth, which the authors say seems to be dominated by ad hoc and subjective policy advice (stemming mainly*	The authors found that the vast majority of degrowth studies are opinion-based, with only a few adopting a system-wide perspective. They argue that this lack of methodological self-

Paper	Citations	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/ Recommendations
		*from **environmental ethics** and **distributional ethics**) (descriptive).*	awareness results in uncritical policy recommendations, political infeasibility, and limited engagement with broader environmental and economic policy literature.
Savini (2024)	14	Economic systems should prioritise well-being over growth (**utilitarianism**, **care ethics**, and **distributional ethics**). Wealth and resource must be redistributed (**distributional ethics**). Excessive consumption must be curtailed (**utilitarianism**, **environmental ethics**, and **distributional ethics**).	The author is in favour of degrowth and post-growth and concludes that policy strategies should prioritise well-being over GDP growth, actively addressing wealth inequality and the environmental impact of affluent individuals and industries. Additionally, the CE should be designed not only to minimise waste but also to promote fair resource distribution and actively reduce environmentally harmful economic activities.
Schneider et al. (2010)	1649	Degrowth can and must replace economic growth to achieve human progress (**utilitarianism, environmental ethics**, and **distributional ethics**). Well-being, ecological sustainability, and social equity should be prioritised over GDP and material growth (**utilitarianism, environmental ethics**, and **distributional ethics**). Degrowth should be a democratic and voluntary process, and not imposed (**care ethics** and **virtue ethics**).	The authors reject green growth and argue for policies such as work-sharing, redistribution, investment in public goods, and alternative economic models. They reject market-based environmental solutions and advocate for institutional reform to enable a transition to degrowth.
Stoknes & Rockström (2018)	189	Green economic growth is not just desirable but necessary for societal well-being and policy success (**utilitarianism** and **anthropocentrism**). Economic growth should be achieved within planetary boundaries (**environmental ethics**). Green growth is a more viable strategy than degrowth to maximise feasibility (**utilitarianism**). Poorer nations should be allowed some level of economic growth even if it means increasing emissions temporarily (**distributional ethics**).	The authors argue that genuine green growth is the most viable strategy for economic stability and justice, political feasibility, and environmental sustainability within planetary boundaries, rejecting degrowth as a viable alternative. They also emphasise that policies should be framed in a way that motivates action, rather than discouraging it.
Sun et al. (2020)	175	Economic growth and environmental sustainability are compatible (**utilitarianism** and **anthropocentrism**).	The authors argue that China's policies should focus on technological innovation and

Paper	Citations	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/ Recommendations
		Social equity and inclusivity should be considered in green growth (**distributional ethics**). Technological progress can overcome environmental issues (**technological optimism** and **anthropocentrism**).	coordinated regional development to achieve inclusive green growth.
Van den Bergh (2011)	844	GDP should not be the primary goal of society because it is not a good indicator of social welfare (**utilitarianism**). Environmental policies are important regardless of GDP growth or degrowth (**environmental ethics**). Degrowth is not an effective or politically viable strategy (**social contract theory**).	The author advocates for shifting to an a-growth strategy by ignoring GDP and moving beyond unconditional support or opposition to growth. They prioritise institutional and behavioural change over economic downsizing.

Case Study 2

Table D3: Overview of the best-fitting implicit ethical theories applied in each analysed paper making (indirect) decisions about the anthropogenic impacts on nonhuman animals.

Paper	Best-Fitting Implicit Ethical Theory/Theories
Ali et al. (2018)	Anthropocentrism, social contract theory, utilitarianism
Anne et al. (2018)	Biocentric and ecocentric environmental ethics, social contract theory, care ethics
Bowles et al. (2019)	Anthropocentrism, utilitarianism, ecocentric environmental ethics
Buchmann-Duck & Beazley (2020)	(Biocentric) Environmental ethics, distributional ethics, care ethics
Damiani et al. (2023)	Ecocentric environmental ethics, anthropocentrism
De Rosa et al. (2021)	Anthropocentrism, utilitarianism, ecocentric and biocentric environmental ethics
Dumont et al. (2013)	Anthropocentrism, utilitarianism
Fiala et al. (2020)	Anthropocentrism, ecocentric environmental ethics, utilitarianism
Junge et al. (2023)	Anthropocentrism, utilitarianism, ecocentric environmental ethics
Kakar et al. (2025)	Anthropocentrism, ecocentric environmental ethics
Lemoine et al. (2024)	Anthropocentrism, utilitarianism, distributional ethics
L. Winter et al. (2017)	Anthropocentrism, ecocentric environmental ethics, distributional ethics
Mace et al. (2014)	Anthropocentrism, utilitarianism
McAuliffe et al. (2016)	Anthropocentrism, utilitarianism, ecocentric environmental ethics
Montoya et al. (2018)	Anthropocentrism, utilitarianism, ecocentric environmental ethics
Paleari (2024)	Anthropocentrism, utilitarianism, ecocentric environmental ethics
Roberts et al. (2023)	Anthropocentrism, utilitarianism
Ruokamo et al. (2023)	Anthropocentrism, utilitarianism, ecocentric environmental ethics
Stephenson & Damerell (2022)	Anthropocentrism, utilitarianism, ecocentric environmental ethics
Taifouris & Martin (2021)	Anthropocentrism, utilitarianism
Teixeira & Domingos (2019)	Anthropocentrism, utilitarianism
Van Zanten et al. (2019)	Anthropocentrism, utilitarianism, ecocentric environmental ethics
Wiengarten & Durach (2021)	Pathocentric environmental ethics, utilitarianism, distributional ethics
Xue et al. (2019)	Anthropocentrism, utilitarianism

Table D4: Overview of the moral assumptions made in each analysed paper making (indirect) decisions about the anthropogenic impacts on nonhuman animals and their impact on the outcomes and recommendations.

Paper	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/Recommendations
Ali et al. (2018)	Nature (including animals) primarily holds instrumental value for humans (**anthropocentrism**). Conservation matters primarily because it aligns with economic benefits and can optimise overall outcomes (**anthropocentrism**, **social contract theory**, and **utilitarianism**).	The authors examine how market-based biodiversity offsets can be integrated into CE policy to address environmental damage from economic development in China. They emphasise biodiversity as a commodity and a functional part of ecosystems, valued primarily for the goods and services it provides to humans.
Anne et al. (2018)	Biodiversity has intrinsic value (**biocentric and ecocentric environmental ethics**).	The authors focus on biodiversity loss as a sustainability challenge in SCM, particularly in the fishing, forestry, and agricultural

Paper	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/Recommendations
	Companies should integrate biodiversity concerns into supply chains beyond legal requirements (**social contract theory** and **care ethics**).	industries. They argue that biodiversity protection should be prioritised within business operations, recognising its intrinsic value while also justifying it in terms of economic, environmental, and social benefits.
Bowles et al. (2019)	The value of livestock is primarily measured in terms of its human utility (**anthropocentrism** and **utilitarianism**). The legitimacy of livestock production is determined by whether it fits within planetary boundaries (**ecocentric environmental ethics**).	The authors examine the environmental impact of livestock production through the planetary boundaries framework, focusing on climate change, biogeochemical flows, and land-system change. They present policy solutions including efficiency improvements, taxation on livestock products, and dietary shifts away from animal-based foods, arising primarily from concerns about environmental sustainability.
Buchmann-Duck & Beazley (2020)	Nonhuman animals and biodiversity have intrinsic moral value (**biocentric environmental ethics**). Current economic systems and CE practices are insufficient for protecting biodiversity (**environmental ethics** and **distributional ethics**). Indigenous and marginalised perspectives should be included in biodiversity conservation (**care ethics** and **distributional ethics**). Technological solutions should not replace ecological protection (**environmental ethics**).	The authors critique the CE's anthropocentric framing, which tends to value biodiversity only in terms of economic and ecological function rather than intrinsic worth. They analyse the potential harm to biodiversity of strategies such as biomimicry, ecosystem service valuation, bioeconomy, and renewable energy. While they acknowledge CE's potential, they argue that current biodiversity protection policies may be insufficient because they focus on economically valuable species, risk harmful technological interventions, and ignore structural inequalities. They call for a more intersectional approach to the CE that explicitly acknowledges its biodiversity limitations.
Damiani et al. (2023)	Biodiversity and species should be preserved due to their functional role in ecosystems (**ecocentric environmental ethics**). The primary reason to assess biodiversity impact is to support human socio-economic systems (**anthropocentrism**).	The authors discuss biodiversity loss, ecosystem impact assessment, and the integration of LCA methods for evaluating biodiversity impacts. They advocate for policy recommendations that prioritise business and economic integration and for biodiversity metrics that emphasise ecosystem-level changes.
De Rosa et al. (2021)	Animal farming is justified because of their utility in economic and environmental systems (**anthropocentrism** and **utilitarianism**). Environmental protection and animal welfare need to be respected (**ecocentric** and **biocentric environmental ethics**).	The authors discuss livestock production within the framework of the CE. They focus on making animal farming more sustainable by reducing waste, enhancing efficiency, and integrating territorial resources. Animals are primarily framed as resources within the CE, valued primarily for their contributions to human and systemic interests.
Dumont et al. (2013)	Animals are primarily resources for human use (**anthropocentrism**).	The authors focus on integrating agroecological and industrial ecological principles into animal production to reduce environmental impact. They discuss

Paper	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/Recommendations
	Animal health is important primarily for efficiency and productivity (**anthropocentrism** and **utilitarianism**). Animal welfare concerns are secondary to economic and ecological concerns (**anthropocentrism** and **utilitarianism**).	management strategies for animal health, biodiversity, pollution reduction, and sustainable farming practices with the aim of optimising animal farming without fundamentally questioning its legitimacy or prioritising animal welfare over economic and ecological concerns.
Fiala et al. (2020)	Deer are primarily a resource for human use (**anthropocentrism**). Hunting is justified for population control and environmental benefits (**ecocentric environmental ethics** and **utilitarianism**).	The authors apply an LCA to the hunting of wild red deer in a mountainous Italian district, evaluating its environmental impact within wildlife management and meat production. They justify hunting as a sustainable meat production method, positioning it as an environmentally friendly alternative to conventional livestock. Framing wildlife management as a necessity, they exclude animal welfare considerations and focus on efficiency improvements.
Junge et al. (2023)	Biodiversity is primarily valuable because it supports economic stability and human well-being (**anthropocentrism** and **utilitarianism**). Species of nonhuman animals matter primarily in the context of ecosystem services (**ecocentric environmental ethics**).	The authors systematically describe the role of biodiversity in sustaining human economies and well-being and suggest ways that CE and industrial symbiosis can mitigate biodiversity loss. They promote biodiversity protection mainly for its economic and ecosystem functions, rather than out of concern for individual animal welfare.
Kakar et al. (2025)	Biodiversity protection is valuable mainly because it serves human needs (**anthropocentrism**). Biodiversity should be preserved because it is a crucial component of Earth's self-sustaining systems (**ecocentric environmental ethics**).	The authors focus on biodiversity conservation within the context of the CE, sustainable infrastructure, and green FinTech, acknowledging biodiversity loss as a consequence of human activity, industrialisation, and economic growth. They frame biodiversity primarily in economic terms and discuss the role of CE initiatives, infrastructure planning, and financial technology in mitigating ecological degradation.
Lemoine et al. (2024)	Urban flora and invertebrate fauna are valued primarily for their contributions to urban aesthetics, biodiversity management, pollination, climate regulation, and economic benefits (**anthropocentrism** and **utilitarianism**). Conservation efforts should focus on species that are not legally protected but are in ecological decline (**distributional ethics**).	The authors frame urban flora and invertebrate fauna biodiversity within the context of urban wasteland regeneration, emphasising ecological restoration, ecosystem services, and rehabilitation. They prioritise chosen biodiversity (species selected for their functional and aesthetic benefits) over wild biodiversity.
L. Winter et al. (2017)	Biodiversity protection is important because humans rely on ecosystem services (**anthropocentrism** and **ecocentric environmental ethics**).	The authors discuss biodiversity impact assessment in LCA, primarily focusing on species diversity and ecosystem impacts, while genetic diversity receives less attention. Their ecosystem-focused approach frames biodiversity in the context

Paper	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/Recommendations
	Biodiversity impact assessments should prioritise highly vulnerable species and ecosystems (**ecocentric environmental ethics** and **distributional ethics**).	of ecosystem services, aligning conservation priorities with human benefits and ecological stability rather than individual animal welfare or intrinsic species value.
Mace et al. (2014)	Animals are primarily economic resources and sources of pollution (**anthropocentrism**). The best model for pig farming is the one that minimises environmental harm while maximising economic gain (**anthropocentrism** and **utilitarianism**).	The authors discuss the environmental and economic benefits of carbon emission reduction in pig farming via the CE, focusing on emissions reduction through a CE model that integrates biogas generation. As a result, pigs are primarily treated as units of production and sources of waste and emissions, with their role framed within economic and environmental efficiency.
McAuliffe et al. (2016)	Pigs are primarily commodities for human use (**anthropocentrism**). Sustainability is defined in terms of human benefits (**anthropocentrism**, **utilitarianism**, and **ecocentric environmental ethics**).	The authors discuss pigs in the context of LCA and primarily focus on the environmental impact, emissions, feed efficiency, and economic performance of pig farming, including feed production, whole-system production, and waste management. Animal welfare improvements may be pursued if they align with economic or environmental goals.
Montoya et al. (2018)	Biodiversity is valuable primarily for its functional role in ecosystems (**anthropocentrism** and **utilitarianism**). Species losses matter primarily in the context of ecosystem services (**anthropocentrism** and **ecocentric environmental ethics**).	The authors argue that conservation decisions must be based on measurable ecological and economic impacts and conclude that policy recommendations should be rooted in pragmatic environmental management.
Paleari (2024)	Animals' primary role in environmental policy is as a resource for human use (**anthropocentrism** and **utilitarianism**). Biodiversity protection is primarily valuable due to its role in maintaining ecosystem services that benefit humans (**anthropocentrism** and **ecocentric environmental ethics**).	The authors analyse the integration of climate change, biodiversity, and the CE within the European Green Deal. They discuss the role of farmed animals in methane emissions, biodiversity conservation strategies affecting wild animals, and the shift towards seafood and algae-based diets, with a primary focus on environmental efficiency.
Roberts et al. (2023)	Biodiversity is primarily useful to human well-being, businesses, and sustainable economic growth (**anthropocentrism**). The value of biodiversity should be measured by its positive outcomes for human societies (**anthropocentrism** and **utilitarianism**).	The authors discuss biodiversity loss as a global issue and frame biodiversity in terms of its value to businesses and human societies. Species extinction is mentioned as part of broader environmental challenges, but corporate disclosures on biodiversity conservation and CE efforts are evaluated mainly in the context of economic and business self-interest, rather than intrinsic animal welfare.
Ruokamo et al. (2023)	Biodiversity protection is instrumental to human well-being (**anthropocentrism** and **utilitarianism**).	The authors discuss biodiversity within the context CE, land use, and material efficiency in Finland. Their analysis focuses on the

Paper	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/Recommendations
	Nonhuman animals are important primarily for their role in ecosystems (**ecocentric environmental ethics**).	effects of biodiversity loss, land use changes, fragmentation, and the pressures exerted by forestry, construction, and industrial activities. Consequently, their focus remains on economic and ecological sustainability rather than the welfare of individual nonhuman animals.
Stephenson & Damerell (2022)	Nature is valuable primarily for its role in human well-being and ecosystem services (**anthropocentrism** and **utilitarianism**). The economic benefits of maintaining healthy ecosystems need to be given more emphasis than the simple use, exploitation and manipulation of biodiversity (**ecocentric environmental ethics**).	The authors focus on ecosystem services in relation to sustainability and biodiversity conservation within bioeconomy and CE models. They discuss species and ecosystems broadly in economic and ecological terms, which means that nonhuman animals are valued primarily for their role in ecosystems and their benefits to humans, rather than for their intrinsic moral worth.
Taifouris & Martin (2021)	Nonhuman animals are primarily economic and environmental resources (**anthropocentrism**). Livestock farming is necessary for environmental and economic efficiency (**anthropocentrism** and **utilitarianism**).	The authors discuss livestock as part of an industrial agricultural system, focusing on its integration with crop production to reduce environmental impact. They model energy and nutritional requirements for cattle, waste treatment, and nutrient recovery, reinforcing the legitimacy of intensive livestock farming as a means to provide economic and environmental benefits.
Teixeira & Domingos (2019)	Livestock should predominantly be assessed in terms of their utility to humans (**anthropocentrism**). An optimal strategy is one that maximises benefits while reducing harm (**utilitarianism**). Livestock systems should be designed to enhance ecosystem services (**anthropocentrism**).	The authors discuss livestock production through the lens of IE, focusing on sustainability, greenhouse gas emissions, and optimisation strategies using LCA and MFA. The aim is to refine sustainability practices in livestock farming while maintaining economic viability. This approach reinforces existing industrial livestock production practices without questioning the justification for using animals or considering their welfare.
Van Zanten et al. (2019)	The role of animals is primarily functional (**anthropocentrism**). The sustainability of the food system justifies the use of animals (**anthropocentrism** and **utilitarianism**). The reduction of animal product consumption is primarily an environmental issue (**ecocentric environmental ethics**).	The authors explore the role of farm animals within a circular food system. They argue that farm animals should be used to convert inedible biomass into valuable food and manure, thereby reducing environmental impact while maintaining food security. Their analysis prioritises environmental sustainability and resource efficiency over the treatment of animals, reinforcing an instrumental view of nonhuman animals within food systems.
Wiengarten & Durach (2021)	Supply chains that use animals cannot be truly sustainable (**pathocentric environmental ethics**).	The authors critique the omission of animal welfare in sustainable SCM research. They argue that while sustainability in SCM has focused on environmental and social dimensions, it largely ignores nonhuman

Paper	Main Moral Assumptions and Best-Fitting Implicit Ethical Theory/Theories	Impact on Outcomes/Recommendations
	Although currently not realistic, the exclusion of animals from supply chains should be the future goal (**pathocentric environmental ethics** and **utilitarianism**). For now, sustainable supply chains should minimise harm to animals (**pathocentric environmental ethics** and **distributional ethics**).	animals despite their role as inputs and outputs in supply chains. They suggest that true sustainability should include animal welfare and that current supply chains inherently exploit animals, making them unsustainable by definition. For pragmatic reasons, however, progress towards animal-free supply chains can only be incremental.
Xue et al. (2019)	Animals are primarily economic and environmental resources (**anthropocentrism**). Economic development and improved living standards for humans justify the production of livestock products (**anthropocentrism** and **utilitarianism**).	The authors examine the environmental and economic benefits of applying CE principles to pig farming and focus on reducing carbon emissions via biogas-based waste treatment. In doing so, they do not question the practice of large-scale animal agriculture.

APPENDIX E: DELPHI SURVEY RESPONSES, QUESTIONS, AND SUMMARIES

V1 = Version adapted to case study 1 (green growth vs degrowth)
V2 = Version adapted to case study 2 (anthropogenic impacts on nonhuman animals)

General

Responses Round 1: **8** (V1) + **4** (V2) = **12**
Responses Round 2: **8** (V1) + **2** (V2) = **10**
Responses Round 3: **6** (V1) + **2** (V2) = **8**

Question 1

V1:

One could argue that most disagreements in sustainability research are not about fundamentally irreconcilable moral differences, but stem from variations in the information being discussed and the methodological approaches used to interpret that information. Few, if any, researchers explicitly argue against the importance of marginalised communities, vulnerable workers, future generations, or nonhuman animals. Rather, these perspectives are sometimes simply omitted. Nevertheless, the ultimate goal of a sustainable and fair economy that stops environmental degradation appears to be widely shared. On this basis, it could be said that a shared moral foundation underlies the debate on how to design a sustainable economic system. It is simply not yet clearly defined or consistently applied, which may contribute to unnecessarily diverging research outcomes and recommendations.

Practical example from the case study:
-   Two papers both agree that we must stay within planetary boundaries and improve well-being. One argues that continued economic growth is possible with the right technologies and policies. The other argues that continuous growth is part of the problem, especially in systems that depend on it. This suggests that the authors share a moral foundation, but diverge due to differences in the scope of and methods used to interpret the information being considered, leading them to draw different conclusions about the consequences that are likely to follow.

To what extent do you agree with this view? Please explain your reasoning.

V2:

One could argue that most disagreements in sustainability research are not about fundamentally irreconcilable moral differences, but stem from variations in the information being discussed and the methodological approaches used to interpret that information. Few, if any, researchers explicitly argue against the importance of nonhuman animals. Rather, their perspective is sometimes simply omitted. Nevertheless, the ultimate goal of creating sustainable and fair economic and ecological systems appears to be widely shared. On this basis, it could be said that a shared moral foundation exists. It is simply not yet clearly defined

or consistently applied, which may contribute to unnecessarily diverging research outcomes and recommendations.

Practical example from the case study:
- Two papers both aim to improve food system sustainability and reduce environmental harm. One focuses on increasing the efficiency of animal farming within existing systems, for example, by improving human health outcomes or reducing pollution, without considering animal welfare. The other argues that circular economy practices inadequately protect biodiversity and should incorporate nonhuman perspectives. These stances suggest that while the authors share a form of moral foundation (prioritising ecological sustainability) they diverge due to differences in the scope of and methods used to interpret the information being considered, leading them to draw different conclusions about the consequences that are likely to follow.

To what extent do you agree with this view? Please explain your reasoning.

Clarification (added in Round 2 survey):
This argument refers specifically to inherently irreconcilable moral disagreements, those that cannot be resolved by any new data or by reaching a consensus on how such data should be interpreted. It suggests that most disagreements in the literature are not insurmountable in this way, which implies that some undefined form of common evaluative ground (i.e., shared moral foundation) already exists.

Aggregated summary (Round 1):
This question was interpreted in different ways, but the vast majority of respondents disagreed with the proposed view. Those who disagreed emphasised that important moral differences exist, stemming from fundamentally different worldviews, beliefs, and definitions of key terms such as "well-being" (case study 1). Some respondents cited existing philosophical debates to highlight that these fundamental moral disagreements are longstanding and well-documented. One respondent pointed out that the broad term "sustainability" itself can obscure underlying moral conflicts (case study 2). Several respondents also noted that trade-offs between different goals, such as environmental protection and economic development, can reflect deep moral differences (case study 1). Even if perfect information were available, they argued, important differences would likely remain regarding what constitutes a desirable outcome.
Those who agreed with the proposed view did so cautiously, suggesting that if researchers truly share the same underlying goals, then disagreements would not be fundamentally moral; however, they stressed that such alignment is rare in practice. They also emphasised the importance of adopting a macroscopic or global perspective on sustainability.
Additionally, some respondents shifted the focus away from researchers and addressed broader moral differences among, for example, politicians and policymakers.

Aggregated summary (Round 2):
Round 2 responses largely reinforced the view that a single shared moral foundation among sustainability researchers is unlikely. Most respondents repeated or deepened their earlier disagreement, stressing that techno-optimists, post-growth thinkers, and decolonial scholars

often begin from fundamentally different worldviews (case study 1). One warned that, were researchers to form a homogenous group with one dominant foundation, other foundations (if and only if they exist) could be sidelined, leading to undesirable outcomes.

Across the responses, the definitions of well-being and sustainability again surfaced as important moral topics: some frame well-being in a hedonic/utilitarian sense, others through the Capability approach, making their interpretations sometimes mutually exclusive. Respondents repeated that even with perfect information and identical data, implicit biases, divergent definitions, and value-laden trade-offs (e.g., current vs future well-being and majority welfare vs that of the most disadvantaged) would still result in different conclusions.

A few participants admitted uncertainty about where "irreconcilable" begins, conceding that at a very abstract level many would endorse a sustainable world, yet stressing that more information will not resolve deep moral dilemmas: the trolley problem illustrates how people can choose differently while appearing to share goals.

Overall, respondents continued to view moral pluralism (not information gaps) as a core source of disagreement.

Aggregated summary (Round 3):

Round 3 responses largely reaffirmed the consensus from earlier rounds. Moral pluralism remains the core source of disagreement in sustainability research. Most respondents reiterated that access to information is not the primary issue. Researchers typically operate with comparable data, and disagreements often persist even when new information is introduced. This persistence, several respondents argued, points to ideological or value-based roots of disagreement rather than epistemic gaps.

Respondents again emphasised the lack of a shared moral foundation, citing deeply divergent worldviews, normative frameworks, and contested definitions of key concepts like well-being and sustainability. While one respondent acknowledged that both moral and methodological differences play a role, most underscored the importance of normative uncertainty and the inescapability of trade-offs that reflect incompatible values. One participant reflected that moral differences are often unrecognised, contributing to frustration and miscommunication in sustainability debates.

A few noted that continued exposure to different ethical theories and paradigms has reinforced their view that no universal foundation exists from which all researchers could derive shared conclusions. Instead, the diversity of theoretical starting points solidifies the view that sustainability discourse is unavoidably shaped by moral pluralism and not merely methodological divergence or information gaps.

Level of agreement with central argument (Likert scale from 1-10):

Most disagreements in sustainability research arise not from irreconcilable moral views but from differences in information and methodology, suggesting an underlying but underdefined shared moral foundation (i.e., some form of common evaluative ground).

Average score round 2: **2.9/10** (Coefficient of Variation: 44.8%; 10 responses)
Average score round 3: **2.1/10** (Coefficient of Variation: 29.8%; 7 responses)

Question 2

<u>V1:</u>

In research on green growth and degrowth, it could be said that a clear moral foundation is essential for coherent and effective decision making. Such a foundation would need to be interpersonal (i.e., without unsubstantiated bias towards certain individuals) and interspecies (i.e., without unsubstantiated bias towards humans). Without this, it becomes impossible to meaningfully scrutinise ethically questionable decisions within this research domain. Consequently, the more clearly this foundation is defined, the more consistent and useful research findings are likely to become.

Practical example from the case study:
- One paper points out that green growth research often does not reflect on its own theoretical foundations, while degrowth research tends to explicitly connect theory with policymaking. This creates an uneven playing field, where green growth initiatives may appear more attractive than degrowth proposals, not necessarily because they are better, but because they avoid confronting relevant consequences. To meaningfully compare both approaches, the assumptions behind green growth should also be made clear and evaluated using the same standards.

To what extent do you agree with this view? Please explain your reasoning.

<u>V2:</u>

In research discussing the anthropogenic impacts on nonhuman animals, it could be said that a clear moral foundation is essential for coherent and effective decision making. Such a foundation would not only need to be interpersonal (i.e., without unsubstantiated bias towards certain individuals) but also interspecies (i.e., without unsubstantiated bias towards humans). Without this, it becomes impossible to meaningfully scrutinise ethically questionable decisions within this research domain. Consequently, the more clearly this foundation is defined, the more consistent and useful research findings are likely to become.

Practical example from the case study:
- Some papers that discuss the environmental impacts of livestock farming treat animals as resources, biomass converters, or merely as sources of pollution, valued mainly for their ecosystem services. Other papers explicitly argue that animal exploitation should eventually be eliminated from supply chains. To meaningfully compare approaches to livestock farming, the assumptions behind these approaches should be made clear and evaluated using the same standards.

To what extent do you agree with this view? Please explain your reasoning.

<u>Aggregated summary (Round 1):</u>

The vast majority of respondents agreed or partially agreed with the proposed view. Supporters emphasised that clarifying and being transparent about moral assumptions is important for meaningful comparison. Similarly, many stated that different paradigms should be evaluated according to comparable standards. However, one respondent cautioned that

this could be misleading, arguing that a set of shared standards does not yet exist and must be developed through processes like reflective equilibrium or immanent critique. Another highlighted that green growth and degrowth are at different stages of development, with different types of weaknesses, making direct comparisons more complex (case study 1). They also noted that not everyone in sustainability research shares the same moral assumptions about the relationship between people and nature, citing ecomodernists as an example (case study 1). Additionally, another respondent raised concerns about the feasibility of interspecies standards, pointing out the practical difficulty that animals cannot communicate their interests directly.

Respondents who disagreed did so for different reasons. One argued that sustainability challenges are too complex to be solved through a single, optimal, or universally comparable approach. They valued maintaining multiple perspectives that highlight different challenges and cautioned against standardisation that might suppress this diversity. Another respondent suggested that, in the context of differing moral views about animals and human responsibilities (case study 2), comparison between perspectives might not be necessary or meaningful. Finally, one respondent found the examples in case study 2 too dissimilar to support a valid comparison.

Aggregated summary (Round 2):

Round 2 responses remained tilted towards agreement that making moral assumptions explicit is valuable, while mostly resisting the call for a single, uniform moral foundation. Many respondents reiterated that the complexity and plurality of sustainability challenges demand diversity and debate, not coherence, warning that installing one dominant standard would be simplifying in undesirable ways. Several again endorsed transparency and that moral reasoning should be "interpersonal and interspecies", yet stressed that multiple foundations can coexist and help illuminate trade-offs rather than erase them.

Those leaning towards agreement argued that clarifying underlying values can reveal common ground, guide better trade-offs, and show why green growth, post-growth, techno-optimist or ecomodernist proposals diverge (case study 1). Yet they doubted that clarity alone would settle disputes.

Respondents who were sceptical echoed the perspectives of those who disagreed in the first round, citing the "utopian" quest for one solution, the practical difficulty of constructing interspecies standards, and the need for spaces where alternative worldviews, especially critiques of human domination through technological progress or extractivism, can be shared. One respondent said examining real-world cases, such as pig farming, can reshape abstract principles, so ethics should adapt through reflection instead of sticking to rigid rules (case study 2). Overall, the respondents valued explicit, plural moral foundations over any single criterion.

Aggregated summary (Round 3):

Round 3 responses continued to support the importance of making moral assumptions explicit in sustainability research, affirming the value of transparency, especially regarding interpersonal and interspecies considerations. However, most respondents maintained that this need not, and should not, imply the establishment of a single, overarching moral foundation. Instead, they reiterated that the complexity and normative diversity of sustainability challenges demand pluralism. Many argued that having multiple, clearly

articulated moral frameworks can help surface trade-offs, guide more reflective comparisons, and support meaningful dialogue rather than suppressing difference.

Respondents stressed that expecting agreement on a unified moral foundation is both unrealistic and potentially counterproductive. Several noted that moral foundations are often incommensurable and cannot be straightforwardly compared or ranked. One respondent warned against delaying practical progress while awaiting a consensus that may never materialise. Others suggested that ethical theories should be treated as provisional tools whose relevance depends on their real-world implications.

While a few participants expressed some hesitation around specific case examples, the overall consensus leaned towards supporting ethical clarity without ethical uniformity. Instead of seeking a single moral standard, respondents emphasised the need for openness about the diverse values underlying sustainability research and for fostering ethical debate as part of the scientific process.

Level of agreement with central argument (Likert scale from 1-10):
Sustainability research requires a clearly defined, interpersonal, and interspecies moral foundation to ensure coherent and effective decision making.

Average score round 2: **4.6/10** (Coefficient of Variation: 44.7%; 10 responses)
Average score round 3: **4.8/10** (Coefficient of Variation: 25.2%; 8 responses)

Question 3

V1:
In research on green growth and degrowth, one could argue that moral principles (such as values, rights, rules, or duties) do not require justification through more fundamental, consequentialist reasoning. From this perspective, the morality of a decision is not determined by its outcomes, but by whether it upholds the relevant principles. Even if acting on these principles would result in worse outcomes than maintaining the status quo, the action would still be considered morally justified.

Practical example from the case study:
- One paper argues in favour of abandoning green growth, even though degrowth is politically unpopular and difficult to implement. In this view, degrowth can be framed as a moral duty. Therefore, even if implementing degrowth fails and leaves us worse off than continuing the status quo, it could still be considered the morally right choice.

To what extent do you agree with this view? Please explain your reasoning.

V2:
In sustainability research, one could argue that moral principles (such as values, rights, rules, or duties) do not require justification through more fundamental, consequentialist reasoning. From this perspective, the morality of a decision is not determined by its outcomes, but by whether it upholds the relevant principles. Even if acting on these principles would result in worse outcomes than maintaining the status quo, the action would still be considered morally justified.

Practical example from the case study:

- One paper argues that companies should go beyond legal obligations to protect biodiversity. In this view, protecting biodiversity can be seen as inherently valuable. Therefore, even if, in an extreme case, implementing policies that unconditionally prioritise biodiversity would bankrupt companies and leave everyone worse off than before, it would still be considered the morally right choice.

To what extent do you agree with this view? Please explain your reasoning.

Aggregated summary (Round 1):
The majority of respondents disagreed with the proposed view, arguing that moral decisions cannot be entirely separated from their consequences. Even principle-based actions, when interpreted broadly, result in relevant outcomes that must be considered (whether material, procedural, or symbolic). Several highlighted the complexity of real-world decision-making, emphasising the need to assess risks and likely outcomes. One respondent viewed justice and sustainability as potential intrinsic moral obligations but saw degrowth as an instrumental tool, not an end in itself (case study 1). Another stressed that principles may guide action under uncertainty, but where negative outcomes are likely, alternative strategies should be explored. One respondent shifted the focus to the economic and institutional feasibility of sustainability research, advocating for a balance between environmental and economic goals. Respondents who agreed or partially agreed supported a pluralist approach. One emphasised that upholding principles contributes to a morally valuable society, which they described as a positive consequence in itself. Another critiqued the framing of the example from case study and proposed a nuanced deontological view grounded in rights-based ethics and W.D. Ross's pluralism: some moral prohibitions (e.g., against torture) may be absolute, while others are conditional and context-dependent. In such views, intentions and principles can outweigh consequences, especially in areas like animal ethics.

Aggregated summary (Round 2):
Round 2 responses again leaned towards rejecting a "principles regardless of consequences" stance. Most respondents repeated that moral decisions cannot be entirely separated from outcomes and urged a practical balance between both worlds: principles and results. Several echoed the first-round view that degrowth is an instrumental means, not a moral duty, whereas duties toward non-human animals (or prohibitions like torture) may be absolute because they avert severe injustice.

Even these critics affirmed the value of pluralism: rights, duties, and intentions are non-consequentialist factors that matter alongside risk-weighted impact assessments. One respondent framed the debate through Rawls's ideal vs non-ideal justice: ideally we uphold what is morally right even without success guarantees, but non-ideal theory reminds us that real-world conditions complicate choices. Here, Henry Shue's principles of avoiding harms and sharing burdens were proposed as a moral guide.

A minority thought consequences ultimately serve fundamental rights and duties, yet agreed those rights must still be specified. Others noted that moral reasoning is contextual: outcomes dominate many sustainability cases, but in some cases principle-based ethics is more apt.

Overall, respondents endorsed a pluralistic, consequence-aware ethics: principles guide, consequences test, and neither alone suffices for coherent sustainability decisions.

Aggregated summary (Round 3):

Round 3 responses largely reinforced the view that moral reasoning in sustainability cannot be fully separated from its consequences. Most respondents continued to reject a rigidly deontological stance that treats principles as valid regardless of outcomes. Instead, they supported a pluralistic and pragmatic approach in which principles and consequences are both essential for moral decision making.

Several respondents described themselves as broadly consequentialist, seeing rights, duties, and justice as important because of the positive outcomes they foster, whether tangible, like the avoidance of harm, or intangible, such as recognition and a sense of being valued. However, even these respondents acknowledged that intentions and moral principles may carry independent weight, particularly when consequences are uncertain or unknowable. One participant made a nuanced distinction: while consequences matter, not all moral justifications must be rooted in them.

A minority expressed partial agreement with the idea that principles can guide action in the absence of outcome guarantees, especially in situations of moral uncertainty. Still, they stressed that known or predictable harms must be taken seriously. Others agreed with earlier rounds that neither principles nor outcomes should dominate; rather, moral judgement in sustainability requires an ongoing, adaptive process in which principles provide orientation and consequences provide critical feedback.

Overall, respondents still supported a reflective, pluralist approach: principles guide decisions, consequences test them, and both must be integrated for effective and ethically sound sustainability research.

Level of agreement with central argument (Likert scale from 1-10):

Moral principles used in sustainability research can be considered justified in themselves, meaning that actions are morally right if they uphold these principles, regardless of their consequences.

Average score round 2: **4.4/10** (Coefficient of Variation: 64.6%; 9 responses)
Average score round 3: **3.7/10** (Coefficient of Variation: 53.3%; 7 responses)

Question 4

V1:

In the context of green growth and degrowth, one could also argue that any moral principle (whether it is a value, a right, a rule, or a duty) gets its moral and scientific relevance from the changes it brings to the experiences of sentient beings. If the application of a principle has no direct or indirect effect on the quality of life of any being, it is hard to see why that choice would have moral significance within scientific research. From this perspective, moral relevance always traces back to the impact on subjective experiences, which implies that all sentient beings should count when evaluating decision making in sustainability research.

Practical examples from the case study:

- Some papers assume that radical redistribution is necessary to achieve justice. This assumption only carries moral weight if it genuinely changes people's lives for the better (i.e., if it leads to overall improved experiences for everyone involved). Therefore, its moral importance stems from its experiential consequences.
- Some papers argue that nature has value beyond its usefulness to humans. However, if valuing nature would not change anyone's experience in any way (human or nonhuman), it becomes difficult to justify why it matters. Therefore, it can be assumed the moral importance of this value has always been rooted in experiential consequences.

To what extent do you agree with this view? Please explain your reasoning.

V2:

One could also argue that any moral principle (whether it is a value, a right, a rule, or a duty) gets its moral and scientific relevance from the changes it brings to the experiences of sentient beings. If the application of a principle has no direct or indirect effect on the quality of life of any being, it is hard to see why that choice would have moral significance within scientific research. From this perspective, moral importance always traces back to the impact on subjective experiences, which implies that all sentient beings (human or nonhuman animal) should count when evaluating decision making in sustainability research.

Practical example from the case study:
- Some papers argue that nature has value beyond its usefulness to humans. However, if valuing nature would not change anyone's experience in any way (human or nonhuman), it becomes difficult to justify why it matters. Therefore, it can be assumed the moral importance of this value has always been rooted in experiential consequences.

To what extent do you agree with this view? Please explain your reasoning.

Aggregated summary (Round 1):

The majority of respondents agreed or partially agreed with the view that moral relevance stems from the impact on sentient experience. However, several raised concerns about its completeness and practicality. One respondent noted that symbolic or relational aspects can affect subjective experience without changing material conditions, and that experiential impacts are often too complex or uncertain to assess reliably. Another questioned whether all moral improvements must be subjectively felt rather than just being objective improvements, and also suggested that the inclusion of nonhuman animals may be a separate moral issue. A third highlighted that subjective well-being can be manipulated or misaligned with objective reality (e.g., feeling unsafe despite falling crime rates), and that deceptive improvements in feeling should not be considered morally just.

One respondent partially disagreed, arguing that other metrics (such as rationality) might also justify moral relevance, not just sentience. Those who disagreed more fully contended that morality can apply even when no conscious experience is affected (for example, that cheating is wrong even if the partner never finds out). Another respondent pointed out that justice is not always about making everyone better off, but about ensuring a minimum standard of well-

being, particularly for the disadvantaged. They also argued that valuing nature should not depend solely on human experiences, especially when animals and plants suffer due to environmental destruction. One respondent rejected the premise of the question altogether, criticising its dichotomous framing and calling for an integrated approach that does not exclude any form of moral reasoning in advance. A few respondents also found the wording or reasoning of the question unclear and therefore did not express a firm view.

Aggregated summary (Round 2):
Round 2 responses stayed divided. Most respondents again disputed the claim that moral relevance always traces back to the experiences of sentient beings. They repeated that justice may require ensuring a minimum standard for the disadvantaged rather than making everyone better off, and stressed that certain acts (cheating, malicious destruction of giant redwoods, unconscious wrongs) seem wrong even when no experience is harmed. Several repeated that rationality or other criteria can ground duties alongside sentience.

Critics also flagged the question's human-centredness and dichotomous framing. One respondent Googled "are birds sentient?" to illustrate confusion over separating nature's value beyond usefulness to humans from sentient experience, noting that birds, fish, mammals (perhaps even insects) are sentient parts of nature. Others pointed to alternative knowledge systems where rivers or trees possess intrinsic value linked to ancestors; such relationality does not rely on instrumentalist or experiential justification.

Even sceptics conceded that the experiences of sentient beings are important, yet warned of practicality problems: How can we truly measure animal feelings or disentangle subjective fear from objective safety? One voice fully endorsed the statement "without sentience there is no evaluation whatsoever", but remained a minority.

Overall, round 2 respondents upheld plural grounds for moral standing, endorsed a "do-no-harm" duty to sentient life, and urged caution against reducing ethics in sustainability research to experiential calculations alone.

Aggregated summary (Round 3):
Round 3 responses continued to express broad but qualified agreement with the idea that the experiences of sentient beings are morally relevant in sustainability research, while reaffirming earlier rounds' emphasis on ethical pluralism. Several respondents agreed that subjective experience plays a central role in moral evaluation, but emphasised that it cannot serve as the sole basis. Rationality, future well-being, ecological integrity, and intrinsic or relational values were all mentioned as additional grounds for moral concern.

Respondents stressed the practical and conceptual limitations of focusing only on sentient experience, particularly given uncertainties in identifying or measuring sentience, especially in nonhuman species. Some proposed expanding the concept of experience to include the well-being of future beings or even systems like rivers or ecosystems, reflecting evolving views in plant cognition and Indigenous knowledge systems. Others maintained that while sentience is necessary for evaluation, it does not exclude other morally relevant criteria.

Overall, the experts upheld the importance of sentient experience in moral reasoning but resisted reducing sustainability ethics to this single dimension. Most respondents endorsed a pluralistic approach that balances subjective experience with broader ethical, ecological, and epistemological considerations.

Level of agreement with central argument (Likert scale from 1-10):
The moral and scientific relevance of the principles used in sustainability research depends on their impact on the experiences of sentient beings.

Average score round 2: **4.9/10** (Coefficient of Variation: 55.6%; 8 responses)
Average score round 3: **5.0/10** (Coefficient of Variation: 38.5%; 7 responses)

Question 5

<u>V1:</u>
Given the previous views, it could be said that the interpersonal and interspecies moral foundation that could benefit sustainability research must be grounded in the weighing of "experiential information" (i.e., information about who is affected by a decision, how they are affected, and for how long). From this perspective, the morality of any decision in green growth and degrowth literature could, in theory, be scrutinised by examining the overall quality of the experiences it produces for all affected sentient beings.

Practical example from the case study:
- Many papers criticise the status quo by highlighting the needs of underrepresented groups, including future generations, Indigenous communities, vulnerable workers, people from the Global South, women in care roles, and nonhuman animals. Taken together, these groups represent a broad spectrum of how sustainability decisions ultimately trace back to information about the lived experience of all sentient beings involved.

To what extent do you agree with this view? Please explain your reasoning.

<u>V2:</u>
Given the previous views, it could be said that the interpersonal and interspecies moral foundation that could benefit sustainability research must be grounded in the weighing of "experiential information" (i.e., information about who is affected by a decision, how they are affected, and for how long). From this perspective, the morality of any decision in literature discussing the anthropogenic impacts on nonhuman animals could, in theory, be scrutinised by examining the overall quality of the experiences it produces for all affected sentient beings.

Practical example from the case study:
- Some papers criticise the status quo by explicitly highlighting the needs of nonhuman animals. When these are considered alongside the needs of humans, they represent a broad spectrum of how sustainability decisions ultimately trace back to information about the lived experience of all sentient beings involved.

To what extent do you agree with this view? Please explain your reasoning.

Aggregated summary (Round 1):

The majority of respondents agreed or partially agreed with the proposed view. Supporters saw value in weighing "experiential information" as a moral foundation for sustainability, especially in relation to underrepresented groups and within the context of the green growth vs degrowth debate (case study 1). However, some noted practical challenges, such as the difficulty and contested nature of quantifying and comparing subjective experiences.

Several respondents raised concerns about the completeness of the approach. One argued that moral concern should extend beyond sentient experience, illustrating this with a thought experiment involving the destruction of an isolated redwood grove that affects no sentient beings but still feels morally wrong. Another echoed this view, highlighting the moral relevance of non-sentient entities like ecosystems, rivers, and communities. One respondent focused on structural injustice, suggesting that the key issue in sustainability is the unwillingness of privileged groups to give up their advantages, rather than how experiences are morally weighed. Finally, a few respondents found the question too complex or unclear to fully engage with.

Aggregated summary (Round 2):

Round 2 responses largely affirmed that weighing experiential information is necessary for ethical scrutiny in sustainability, yet most insisted it is not sufficient to ground the entire moral foundation. Participants reiterated that experiences of sentient beings are important and relevant, but should be treated as one component among others.

Respondents again flagged practical and epistemic hurdles: obtaining the totality of all experiential information for every stakeholder (human, non-human, present, future) is practically impossible; much data lies in an unknown future, and even current feelings are hard to access, interpret, and compare. Several called for methods going beyond conventional empirical tools, noting the need to resolve contested terms (like well-being, suffering, justice, degrowth, or even sentience) and develop new methodologies.

Debate persisted over who counts. One respondent accepted the statement only if redwood groves, rivers, and even Earth as a whole qualify as sentient, while others upheld a distinction between impacts on sentient beings and non-experiential harms to ecosystems or cultural relations. A structural injustice lens re-emerged: the core obstacle may be the unwillingness of privileged groups to give up advantage, which experiential accounting alone cannot fix.

Overall, respondents viewed experiential information as a valuable but partial lens, crucial for highlighting under-represented voices, yet unable, by itself, to capture the full moral landscape.

Aggregated summary (Round 3):

Round 3 responses continued to support the view that weighing experiential information is an essential but insufficient basis for ethical scrutiny in sustainability research. Most respondents affirmed that the experiences of sentient beings ,particularly their suffering, well-being, and vulnerability, should play a central role in sustainability ethics. However, they also reiterated earlier concerns about practical challenges in assessing and comparing such experiences, especially for nonhuman life and future generations.

Several participants reflected on the emotional importance of sentient suffering, acknowledging the intuitive moral weight of visible pain or fear, particularly in humans and nonhuman mammals. Yet they agreed that moral decision making must go beyond emotional

reactions, requiring broader frameworks that incorporate justice, structural power imbalances, and the value of non-sentient entities such as ecosystems.

Some respondents advocated for an expanded notion of sentience and experience, while maintaining that experiential information alone cannot address deeper systemic issues or fully capture moral relevance. Overall, the experts endorsed experiential information as a valuable lens, especially for highlighting overlooked harms, but emphasised the need for complementary ethical perspectives.

Level of agreement with central argument (Likert scale from 1-10):

Decisions in sustainability research can be scrutinised using experiential information (i.e., information about who is affected by a decision, how they are affected, and for how long).

Average score round 2: **5.9/10** (Coefficient of Variation: 32.3%; 8 responses)
Average score round 3: **6.1/10** (Coefficient of Variation: 17.2%; 8 responses)

Extra question (only for V2)

One could argue that a key element of the shared moral foundation in sustainability research is the assumption that no human life matters more than another. However, the experiences of nonhuman animals might require a different kind of moral weighting. One proposal is to weigh experiences based on an animal's "experiential complexity" (i.e., the vividness, intensity, and richness of what that animal can feel or perceive). Purely as a hypothetical example, if we were to discover that human pain is experienced twice as intense as that of a cow, then, assuming all else is equal (such as duration, context, and relative impact), a painful experience would carry twice the moral weight for a human as it would for a cow.

To what extent do you agree with this view? Please explain your reasoning.

Aggregated summary (Round 1):

Most respondents agreed (in principle) with the proposed view. They indicated that moral weight should be assigned to experiences (such as pain or pleasure) based on how vividly and intensely different species can perceive them. One respondent referenced research on expressing improvements in animal welfare using metrics like DALYs (Disability-Adjusted Life Years), suggesting such tools could support cross-species ethical decision-making. One respondent, however, appeared unclear about the premise or the specific view being evaluated.

Aggregated summary (Round 2):

No additional comments were made for this question.

Aggregated summary (Round 3):

The Round 3 response reaffirmed that experiential complexity is a relevant consideration for weighing moral impacts across species, supporting the idea that differences in perceptual vividness and intensity matter ethically. However, the respondent cautioned against reducing moral worth solely to experiential intensity. They argued that other factors, such as rights, capabilities, and the moral significance of how beings are treated, also contribute to the value

of a life. While broadly agreeing with the view presented, the respondent advocated for a more pluralistic ethical approach that integrates experiential considerations with additional moral principles.

Level of agreement with central argument (Likert scale from 1-10):
While sustainability research tends to assume all human lives have equal moral worth, nonhuman animals require moral weighting based on their experiential complexity.

Average score round 2: **7.0/10** (Coefficient of Variation: 0%; 2 responses)
Average score round 3: **6.5/10** (Coefficient of Variation: 7.7%; 2 responses)

Question 6

V1:
One could argue that because we cannot precisely measure the effects of decisions on all affected experiences, or compare those experiences with complete accuracy, a moral foundation that is both fully objective and complete is ultimately unattainable. However, the more we study the experiential outcomes of potential decisions, the more systematically we could approximate such an ideal. From this perspective, sustainability research should always strive to gather, interpret, and clearly communicate comprehensive experiential information when making assumptions, drawing conclusions, or offering recommendations.

Practical example from the case study:
- Most papers argue that ongoing economic growth cannot go hand in hand with protecting the environment, reducing inequality, and supporting long-term well-being. Instead, they call for using fewer resources, sharing wealth more fairly, and redesigning the economic system. To justify the morality of these proposals convincingly, researchers need to clearly demonstrate which people and animals would be affected by such changes, in what way, and for how long. The better they can do this, the stronger their case will be grounded in a shared moral foundation.

To what extent do you agree with this view? Please explain your reasoning.

V2:
One could argue that because we cannot precisely measure the effects of decisions on all affected experiences, or compare those experiences with complete accuracy, a moral foundation that is both fully objective and complete is ultimately unattainable. However, the more we study the experiential outcomes of potential decisions, the more systematically we could approximate such an ideal. From this perspective, sustainability research should always strive to gather, interpret, and clearly communicate comprehensive experiential information when making assumptions, drawing conclusions, or offering recommendations.

Practical example from the case study:
- Many papers argue that protecting biodiversity should be a priority. Some also call for animal welfare to be considered alongside environmental goals, even suggesting that supply chains should eventually change. To justify the morality of these proposals

convincingly, researchers need to clearly demonstrate which people and animals would be affected by such changes, in what way, and for how long. The better they can do this, the stronger their case will be grounded in a shared moral foundation.

To what extent do you agree with this view? Please explain your reasoning.

Aggregated summary (Round 1):
The majority of respondents agreed or partially agreed with the proposed view, emphasising that while moral knowledge can never be fully objective or complete, moral arguments become more persuasive when researchers effectively explain who will be affected and how (i.e., by providing descriptive information). One respondent added that although experiential evidence strengthens moral reasoning, it cannot fully objectify it, as the act of weighing different experiences remains a moral judgement rather than an empirical process. Two others stressed that aiming for complete understanding may delay necessary action, arguing that since perfect knowledge is unattainable, decisions must eventually be based on information that is "good enough".

Among those who disagreed, one respondent argued that moral reasoning alone, no matter how well-supported by evidence, is often insufficient to drive change, and that researchers should highlight how overconsumption also harms the privileged (case study 1) to increase receptiveness. Finally, one respondent expressed uncertainty, asking for clarification on the meaning of a "fully objective and complete moral foundation" before they could respond.

Aggregated summary (Round 2):
Round 2 responses converged on a "necessary-but-not-sufficient" view. Most respondents agreed that documenting "who will be affected and how" strengthens moral reasoning, yet repeated that weighing different experiences remains a moral judgement, not an empirical process.

Supporters explicitly endorsed experiential information as a tool to motivate and adjust our moral foundations, while warning that perfect information is near-impossible: researchers need a reasonable cut-off or risk being bogged down and delaying action. Several added that moral reasoning alone will not drive change; complementary tactics, such as showing harm to the privileged or redesigning institutions, are also required.

A recurring caution targeted Western academic positionality: scholars with "white privilege" should not speak for Indigenous or Global-South stakeholders, but rather create spaces of empowerment so affected groups can voice their own experiences.

One respondent accepted that experiential information can ground one possible moral approach but strongly disagreed that it could even begin to approximate a complete and fully objective foundation, but remained a minority. Echoing round 1 concerns, they stressed that other moral dimensions (rights, structural injustice, intrinsic value) must complement experiential metrics.

Overall, respondents saw comprehensive experiential information as indispensable for persuasive sustainability arguments, yet insist it cannot by itself deliver an ideal, exhaustive moral framework.

<u>Aggregated summary (Round 3):</u>

Round 3 responses aligned closely with earlier rounds, reaffirming the "necessary-but-not-sufficient" view. Most respondents agreed that studying and communicating experiential information significantly strengthens moral reasoning in sustainability research. However, they maintained that weighing such experiences remains a moral judgement, not a purely empirical process.

While a few expressed scepticism about the attainability of truly comprehensive experiential data, they still endorsed the pursuit of such information as valuable and worthwhile, provided it does not delay urgent action. Several emphasised that experiential data should be complemented by other moral considerations, such as rights, structural injustice, or intrinsic value. One respondent noted that the question's cautious framing made it easier to support, while others simply endorsed the consensus from Round 2. Overall, respondents continued to see experiential information as a key ethical tool: important for justification, but not sufficient to construct a complete moral foundation on its own.

<u>Level of agreement with central argument (Likert scale from 1-10):</u>

While a fully objective and complete moral foundation is unattainable in sustainability research, systematically studying and communicating experiential information can help approximate this ideal.

Average score round 2: **6.3/10** (Coefficient of Variation: 40.1%; 9 responses)
Average score round 3: **6.1/10** (Coefficient of Variation: 34.1%; 8 responses)

APPENDIX F: HoME PROFILE DOCUMENTS

Template

HoME Profile * Template

Scientific Contribution
****

Core Recommendation or Main Conclusion
****

Underlying Assumptions
****

Affected Groups	Experiential Impacts
****	
****	
****	
****	
****	

* The Holistic Moral Evaluation (HoME) Profile is an overview that clarifies the core message and potential impact of sustainability research, makes its moral assumptions explicit, and helps communicate its findings more clearly to a broader audience.

Instruction manual

HoME Profile Instruction Manual

General Instructions:

➢ The HoME Profile is a one-page overview designed to help you clarify the core message and potential impact of your research, make its moral assumptions explicit, and communicate its broader meaning beyond academia.

➢ Use plain language, and avoid terms or references that may be unfamiliar to the general public. The profile should be easily understandable to someone without a scientific background.

➢ Do not underestimate the challenge of creating a good HoME Profile. Balancing scientific honesty with accessible communication requires an iterative process and careful reflection. Consider seeking feedback from readers unfamiliar with your work.

<Official title of your research>   **HoME Profile**

Scientific Contribution
Clarify what your research adds to the existing body of scientific knowledge. What insight, method, or tool did you create or improve?

Core Recommendation or Main Conclusion
Clarify what you want researchers, policymakers, practitioners, or society to do with this new knowledge. What should be done differently compared to the status quo? What action do you recommend? If your research is not intended to support a specific recommendation, you can instead summarise its main conclusion or insight.

Underlying Assumptions
Clarify the underlying values, rights, virtues, rules, duties, or other principles that justify your core recommendation or conclusion. What normative views shaped the way you framed your research, set its boundaries, or interpreted its results?

Instructions for the First Three Sections:

➢ Write these sections in the first person. Take clear ownership of your specific scientific contribution and normative views.

➢ Your scientific contribution and core recommendation should clearly reflect the practical relevance of your research, even in the face of uncertainties or trade-offs.

➢ Be transparent when describing your underlying assumptions. Confidence in the scientific and moral integrity of your work should support, not avoid, ethical reflection and scrutiny. If relevant, you can mention a specific ethical theory that guided your reasoning by adding it in parentheses at the end.

➢ Limit each section to a maximum of five lines, preferably fewer.

HoME Profile Instruction Manual

Affected Groups[*]   **Experiential Impacts**

List the groups of people and animals who would be affected if your core recommendation were implemented, or in light of the conclusion you have drawn:

Clarify how the lived experience of each group would likely be impacted if your recommendation were implemented, or as a result of the conclusion you have drawn:

Group A   *Would…*

Group B   *Would…*

Group C   *Would…*

Group D   *Would…*

[*]Common groups to consider include policymakers, researchers, workers, consumers, farm animals, and wildlife. However, it is important not to overlook often underrepresented groups who may experience unique impacts, such as local communities, Indigenous peoples, informal workers, and less familiar or 'non-charismatic' animal species. Additionally, please ensure that the potential effects on future generations within each group are also taken into account.

Instructions for the Last Section:

➢ Absolute accuracy is not possible in this section. Instead, walk the reader through your best-informed estimation of how the implementation of your core recommendation or the conclusion you have drawn would affect the groups involved.

➢ Be as inclusive as possible when identifying affected groups. Rather than selecting only those you consider most important, aim to list all groups of people and animals likely to be affected. Omitting relevant groups can weaken the credibility of your analysis. First list the groups containing humans, then the groups containing nonhuman animals.

➢ If multiple groups would experience similar impacts, they may be grouped together or described under a shared label such as "any person (or animal) affected by…".

➢ Ensure that each listed group and its corresponding experiential impact form a continuous sentence written in the present conditional (e.g., "Group A would…"). This helps maintain clarity, consistency, and a smooth reading flow across all entries.

Example from case study 1

Can renewable energy transition drive green growth? The role of good governance in promoting carbon emission-adjusted economic growth in Next Eleven countries

HoME Profile *

Scientific Contribution

By defining 'green growth' as faster economic growth than per-person carbon emissions growth, I found that in eleven fast-growing countries, renewable energy only supports such green growth when good governance is in place. In contrast, more trade, urban expansion, and industrial growth usually make it harder to achieve.

Core Recommendation

I recommend that researchers and governments adopt this new 'emission-adjusted way of measuring green growth' as part of the larger goal of good governance. It offers a clearer basis for making informed decisions about policy, energy, and where public money should go.

Underlying Assumptions

I assume that genuine human progress means growing the economy through fair and transparent governance without harming the planet, so that both people and the environment can thrive together.

Affected Groups   ### Experiential Impacts

Government workers and policymakers	Would be able to assess sustainable growth more clearly and make more informed decisions based on emissions and economic performance.
Researchers	Would align their work more closely with policy needs, collaborate across disciplines, and adopt clearer, more detailed methods to better understand how economic growth and environmental impact are connected.
People living in fast-growing economies	Would experience more accountable governance, changes in job opportunities as economies shift towards green growth, and economic progress that better protects their long-term well-being.
All people and animals affected by carbon emissions	Would benefit from a more stable climate and the improvements this would bring to the quality of their lives.

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Example from case study 2

Prospects from agroecology and industrial
ecology for animal production in the 21st century

HoME Profile *

Scientific Contribution

We developed five nature-based and resource-saving principles for making animal farming more sustainable and illustrated them using six real-world farm examples.

Core Recommendation

We recommend that farmers, researchers, policymakers, and other people involved put our five principles into practice. This means keeping animals healthy naturally, relying less on the purchase of feed and chemicals, turning waste into useful resources, boosting diversity on farms, and protecting overall biodiversity.

Underlying Assumptions

We assume that people involved in animal farming should share responsibility to protect the environment, ensure animal welfare and health, and share Earth's resources so that both present and future generations can be fed.

Affected Groups   ### Experiential Impacts

Farmers

Would follow clearer and more practical principles, explore ways to cut costs and pollution, and have greater confidence that their animals stay healthy.

Researchers, policymakers, and extension agents

Would share a common set of principles, translate science into clearer advice, and more easily judge whether new tools and policies are right for people and nature.

Any person affected by animal farming

Would benefit from cleaner air and water, healthier environments to live in, and more resilient food production over time.

Livestock animals

Would live in environments better suited to their natural needs, with reduced stress and disease, which lead to healthier lives.

Wildlife

Would lose fewer places to live, be exposed to fewer harmful substances, find more diverse and connected landscapes, and have greater chances to live well alongside farms.

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