
The Interconnected Blueprint: A Comprehensive Assessment of Synergies and Trade-Offs Across All 17 Sustainable Development Goals

Author: Oliver Smith

Affiliation: Swiss International University (SIU)

ORCID ID: 0009-0001-8637-7727

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Abstract

Quantitative assessments of how the 17 Sustainable Development Goals interact have produced two incompatible verdicts from broadly the same official indicator data. One body of work reports that positive associations between goal pairs outnumber negative ones, with the synergy share rising above nine-tenths of total influence once indirect paths are admitted. Another reports that no country meets basic human needs within sustainable resource use, that gains on social goals travel with larger environmental footprints, and that no observed national trajectory has advanced all 17 goals together. This review reconciles the two positions by treating the measured synergy-to-trade-off ratio not as a property of the goal system but as a joint product of five specification choices: the accounting boundary, the analytical object, the indicator set and estimator, the order of interaction admitted, and the scale of observation. Coding 34 sources against these axes shows the disagreement is patterned rather than random: territorial, cross-sectional, level-based, indirect-path, globally averaged designs generate synergy optimism, while consumption-based, change-based,

trajectory-based and subnational designs recover structural conflict. The paper develops a Conditional Interaction Assessment framework, states five testable propositions, and proposes a reporting specification under which an interaction estimate becomes interpretable. The implication for policy is that a single global synergy statistic carries little transfer value to any particular jurisdiction, and that interaction evidence entering national planning should be specified before it is used.

Keywords: sustainable development goals, goal interactions, synergies, trade-offs, policy coherence, integrated assessment

1. Introduction

Two peer-reviewed assessments of the same goal system, published two years apart and drawing on official indicator data, reach conclusions that cannot both guide policy. Xiao et al. (2022) report that once indirect interlinkages are admitted into the network, synergistic effects account for as much as 98.33% of total influence across the Sustainable Development Goals. Carlsen et al. (2024) test whether any country's observed historical path is consistent with progress on all 17 goals and find none. A planner reading the first result would look for entry points that pull the whole system upward. A planner reading the second would prepare to arbitrate losses. The gap between those two postures is the difference between an agenda that coheres and one that does not.

This is not a marginal disagreement about magnitude. It is a disagreement about the sign of the system. The literature has absorbed it largely by treating the two clusters as separate conversations: statistical interaction studies cite one another, and biophysical-limits studies cite one another, with limited traffic across the boundary. Where the divergence has been noticed, it has been attributed to isolated technical causes. Bennich et al. (2020) reviewed 70 studies and found no consensus on conceptual framing or assessment method. Warchold et al. (2022) built a unified database from United Nations, World Bank and

Bertelsmann Stiftung indicator sets and found that interaction patterns derived from them are more different than similar, with environmental goals diverging most. Ospina-Forero et al. (2022) showed that alternative network estimators applied to the same development indicators return materially different structures. Song and Jang (2023) questioned whether the 17-goal partition is even the right analytical unit, since the most tightly connected targets cut across goal boundaries.

Each of these findings is a warning about a single step in the analytical chain. None of them explains why the aggregate verdict flips, and none tells a reader what an interaction claim would have to state before it could be believed. That is the gap this paper addresses. The problem matters because interaction evidence is no longer confined to journals: it enters Voluntary National Reviews, sequencing arguments, and the design debate over what follows 2030 (Allen et al., 2021; Independent Group of Scientists appointed by the Secretary-General, 2023). A number chosen from the optimistic end of a specification-dependent range can license a national strategy that assumes conflicts away.

I argue that the synergy-to-trade-off ratio reported in any given study is not an estimate of a fixed quantity. It is a joint product of five analytical choices, and the two literatures are not contradicting one another so much as answering different questions under the same name. The paper makes three contributions. It reconciles the opposing clusters by showing that their disagreement is patterned along identifiable specification axes rather than distributed randomly. It develops a Conditional Interaction Assessment framework, expressed as five propositions that can be tested by re-running existing data under paired specifications. And it proposes a reporting specification under which an interaction estimate becomes interpretable by someone who did not produce it.

The review proceeds by first setting the conflicting evidence side by side, then working through the specification axes that separate the clusters: accounting boundary,

analytical object, indicator and estimator choice, and interaction order together with scale.

The framework and its propositions follow, before the discussion turns to what this means for how goal interactions are reported and used.

2. Review Approach

Three questions organise the review. Under what analytical conditions does the empirical literature report that synergies dominate, and under what conditions does it report structural conflict? Which specification choices account for the divergence between those conditions? And what would an interaction claim need to state for a reader to interpret it?

The design is an integrative review rather than a systematic review or meta-analysis, and the choice follows from the questions. A meta-analysis pools comparable effect estimates; the corpus here contains cross-sectional correlation studies, network estimation, cross-impact scoring, integrated assessment modelling, consumption-based environmental accounting and qualitative archetype analysis, which share no common effect metric. A systematic review maps a field's coverage, and Bennich et al. (2020) have already produced that map with a coding scheme and reading guide. Repeating the count would add little. The question here is why methods that all claim to measure SDG interactions disagree about the sign of the system, which is a conceptual question answered by structured comparison rather than by pooling.

Sources were identified through searches of scholarly databases indexing Scopus, Semantic Scholar, PubMed and arXiv records, a semantic full-text scholarly search service covering major publisher corpora, and targeted searching of publisher and intergovernmental repositories for material that indexed databases cover poorly. Search strings combined ("Sustainable Development Goals" OR "SDG") *with* (*synerg* OR "trade-off" OR *interaction* OR *interlinkage* OR *interdependen*) and with (network OR correlation OR model OR "planetary boundaries" OR footprint OR governance). The window ran from 2015, the year

the goals were adopted, to 2026, with earlier work retained only where later studies build directly on it.

Studies entered the review when they met four criteria: peer-reviewed article, book chapter, or intergovernmental scientific assessment; an analytical claim spanning multiple goals rather than a single pair; an explicit statement of data source and analytical procedure; and publication in English. Single-sector applications with no cross-goal claim were excluded, as were commentaries offering no evidence and any work flagged as retracted. Applying these criteria yielded 34 sources: 30 journal articles, two intergovernmental assessments, and two methodological reviews that also function as evidence about the field's heterogeneity.

Every reference was verified against CrossRef metadata records or, for material without a digital object identifier, against the publisher's own page, with authors, year, journal, volume and pagination confirmed before the source entered the analysis. No claim in this paper rests on a source whose metadata could not be confirmed at that level.

Each retained study was then coded on five dimensions drawn inductively from an initial reading: the accounting boundary of its indicators, whether it analysed levels or changes, its indicator set and estimator, whether it admitted indirect paths, and the scale at which it observed. Its headline verdict on the balance of synergies and trade-offs was recorded alongside. Table 1 presents the coded comparison for the studies that make system-level claims. The framework in the later sections was derived abductively from that table by asking which specification differences separate the synergy-dominant cluster from the trade-off-dominant one.

Two safeguards limit the risk that the coding simply confirmed a prior expectation. Disconfirming evidence was searched for deliberately: the trade-off cluster was assembled by looking for work that contradicts the correlation studies, and the correlation studies were read for internal exceptions rather than summarised by their abstracts. Studies whose conclusions

cut against the argument developed here, including Hegre et al. (2020), which finds synergy dominance in changes as well as levels, are engaged where they resist the pattern rather than filed under it. The review nonetheless carries real boundaries. It applies no formal quality appraisal, makes no claim to exhaustive coverage, and cannot rule out that the specification axes it identifies are themselves correlated with unobserved features of the studies. Claims about mechanism in what follows are interpretive, derived from comparison across published designs rather than from re-estimation, and are marked as such.

Table 1

Specification profiles and headline verdicts of major cross-goal interaction assessments

Study	Evidence base	Analytical object	Accounting boundary	Order	Headline verdict
Pradhan et al. (2017)	Official SDG indicators, 227 countries	Levels (cross-section)	Territorial	Direct	Positive indicator pairs outweigh negative ones; SDG 12 most often in trade-offs
Scherer et al. (2018)	166 nations split into four income groups, trade-linked model	Levels, footprints	Consumption-based	Direct	Progress on social goals travels with higher carbon, land and water impacts
O'Neill et al. (2018)	Over 150 nations, needs indicators against downscaled boundaries	Levels vs. absolute thresholds	Consumption-based	n/a	No nation meets basic needs at a sustainable level of resource use
Kroll et al. (2019)	Global indicator trends and projections to 2030	Levels and change	Territorial	Direct	Synergies around SDGs 1, 3, 7, 8, 9; persistent trade-offs for SDGs 11, 13, 14, 16, 17
Lusseau and Mancini (2019)	Global time series, countries grouped by income	Change, estimated network	Territorial	Direct	Interaction structure differs by income; climate, inequality and consumption are the principal hurdles
Hegre et al. (2020)	Global indicators 2000–2016, principal component analysis	Levels and change	Territorial	Direct	Synergies prevail in levels and change; SDG 10 the exception
Warchold et al. (2020)	Global indicators by population, region, income	Levels	Territorial	Direct	Synergies outweigh trade-offs; pattern varies by income and region
Pham-Truffert et al. (2020)	Interaction network built from literature review	Documented links	Mixed	Direct and indirect	Systemic multipliers and virtuous cycles identified as entry points
Zeng et al. (2021)	~180 countries, trade-embodied environmental impacts	Levels	Telecoupled, consumption-based	Direct	Telecoupling relocates environmental trade-offs rather than resolving them
Xiao et al. (2022)	SDG indicator network, plus-minus DEMATEL model	Levels	Territorial	Direct and indirect	Synergy effects reach 98.33% of total influence
Zhang et al. (2022)	31 Chinese provinces, 2000–2020	Levels and change	Territorial, subnational	Direct	Trade-offs in eastern provinces; synergies weakening over the decade

Study	Evidence base	Analytical object	Accounting boundary	Order	Headline verdict
Kostetckaia and Hametner (2022)	EU member states, measured interlinkages and progress	Rates of progress	Territorial	Direct	Trade-offs slow national progress more than synergies accelerate it
Ospina-Forero et al. (2022)	87 indicators, four countries, 20 years	Levels, several estimators	Territorial	Direct	Estimated network structure varies materially with the estimator chosen
Warchold et al. (2022)	UN, World Bank, Bertelsmann sets combined	Levels	Territorial	Direct	Interaction patterns are more different than similar across data sources
Carlsen et al. (2024)	Historical national indicator trajectories	Trajectories	Territorial	Direct	No observed trajectory is consistent with progress on all 17 goals
Fairbrass et al. (2024)	231 SDG indicators, environmental policy modelling	Levels and change	Territorial	Direct	Environmental gains show no evidence of translating into social benefits
Xiao et al. (2024)	768 indicator pairs, four transmission channels	Levels	Transboundary	Direct	High-income countries hold 14.18% of population and 60.60% of total interactions

Note. Compiled by the author from the cited studies. “Analytical object” records whether a study analyses cross-sectional levels, rates of change, or whole trajectories; “accounting boundary” records whether environmental pressure is attributed territorially or to final consumption. Where a study combines designs, the classification reflects the design behind its headline claim.

3. Two Verdicts from One Indicator Set

The synergy-dominant reading rests on a coherent sequence of studies. Pradhan et al. (2017) correlated pairs of SDG indicators across 227 countries, classified significant positive correlations as synergies and significant negative ones as trade-offs, and found positive pairs outweighing negative ones in most countries, with SDG 1 synergistic with most other goals. Warchold et al. (2020) disaggregated the same style of analysis by population, region and income and again found synergies outweighing trade-offs, with linear interactions outweighing non-linear ones. Hegre et al. (2020) summarised the goals through principal component analysis of global indicator data for 2000 to 2016 and reported that synergies prevail in levels and in change alike, with SDG 10 the exception that has not moved in step with the rest. Xiao et al. (2022) added indirect interlinkages through a plus-minus DEMATEL model and returned the 98.33% figure. Pham-Truffert et al. (2020) built a network from a literature review rather than indicator data and identified systemic multipliers and virtuous cycles usable as entry points.

The opposing reading is equally well evidenced and rests on different measurement. O'Neill et al. (2018) compared the resource use associated with meeting basic human needs against downscaled planetary boundaries for over 150 nations and found that no country meets basic needs at a globally sustainable level of resource use, with universal achievement of more qualitative goals requiring two to six times the sustainable level. Scherer et al. (2018) modelled 166 nations split into four income groups within a trade-linked consumption framework and found that progress on poverty and inequality goals travels with higher carbon, land and water impacts. Fairbrass et al. (2024) modelled 231 SDG indicators, found protected areas and forest certification associated with improvements in forest and water ecosystems, and found no evidence that those environmental gains translate into social benefits while the global environmental state continues to decline. Carlsen et al. (2024) found no historical trajectory consistent with progress on all 17 goals. Kostetckaia and Hametner (2022) related measured interlinkages to observed progress in European Union member states and found trade-offs exerting a larger influence on the pace of progress than synergies.

The synergy cluster already contains the seed of the conflict. Pradhan et al. (2017) identified SDG 12 as the goal most frequently associated with trade-offs. Kroll et al. (2019) projected trends to 2030 and located synergies around SDGs 1, 3, 7, 8 and 9 while finding persistent trade-offs and non-associations for SDGs 11, 13, 14, 16 and 17. Hegre et al. (2020) excepted SDG 10. Read together, these exceptions are not scattered: they concentrate in the environmental goals and the institutional ones. The synergy majority is therefore a majority computed over a set of pairs in which the socioeconomic goals, which co-vary strongly with development level, are heavily represented.

Why has the field not resolved this? Part of the answer is bibliographic. The correlation studies and the biophysical-limits studies form largely separate citation communities, publishing in different outlets and addressing different audiences, so neither

treats the other as a rival estimate of the same quantity. Part of it is how the discrepancy has been classified. Bennich et al. (2020) documented the methodological heterogeneity carefully, but framed it as a coverage and comparability problem to be managed through better reading practice rather than as a threat to the validity of the field's central claim. Managing heterogeneity and explaining a sign reversal are different tasks, and only the first has been attempted.

That leaves the argument of this review. The disagreement between the clusters is not noise. Studies reporting synergy dominance share a design profile: territorial indicators, cross-sectional levels, national aggregates, global averaging, and in several cases the admission of indirect paths. Studies reporting structural conflict share the opposite profile. What separates them is specification, and the four sections that follow take each axis in turn.

4. Accounting Boundaries and the Displacement of Trade-Offs

Whether a trade-off appears in a country's statistics depends on where the accounts are drawn. Territorial indicators attribute environmental pressure to the place where it physically occurs. Consumption-based accounts attribute it to the place whose final demand caused it. The goals themselves are monitored predominantly on the territorial basis, and this choice does analytical work that is rarely stated.

Zeng et al. (2021) show how much work. Analysing roughly 180 countries, they find that around 78% of SDG indicators show statistically significant correlations with telecoupled environmental impacts embodied in trade, and that accounting for these distant impacts reduces the apparent trade-offs between environmental and development goals in developing countries, because the pressure has been relocated rather than avoided. Xiao et al. (2024) quantify the same displacement from the other direction, tracing transboundary interactions through trade, river flow, ocean currents and air flow across 768 pairs of SDG indicators. High-income countries hold 14.18% of world population and account for 60.60% of total

SDG interactions. Trade-mediated synergies run 14.94% stronger with distant partners than with neighbours, while nature-mediated flows produce 39.29% stronger synergies among neighbouring states.

Scherer et al. (2018) and O'Neill et al. (2018) complete the picture at the level of absolute limits. When social achievement is priced in consumption-based resource terms and compared against downscaled biophysical ceilings, the conflict between social and environmental goals is not a statistical tendency that better policy might dissolve. It is the current configuration of provisioning systems, and O'Neill et al. quantify the distance: no nation is presently inside both boundaries.

The boundary is not a neutral technical default. It is built into the monitoring architecture on which most interaction studies depend, since the official indicator set records environmental pressure predominantly where it is emitted, extracted or discharged rather than where the demand for it originated. A country that imports the material-intensive stages of its consumption improves on the indicators the correlation studies read while the physical pressure continues to be generated elsewhere. Warchold et al. (2022) show that environmental goals are exactly where alternative indicator sets diverge most, which is what one would expect if the boundary convention were doing heavy and unacknowledged work. Treating this as a reason to distrust environmental indicators would be the wrong response; the point is that a boundary convention chosen for administrative reasons has become an analytical assumption without ever being argued for.

The interpretive consequence follows directly. A territorial accounting boundary does not remove a trade-off from the world; it removes it from the national statistic in which the correlation is computed. Under consumption-based accounting the same country pair can move from synergy to conflict, and the effect is concentrated exactly where the exceptions in the correlation literature already cluster, in SDGs 12 through 15. Any global statement about

the balance of synergies and trade-offs that does not name its accounting boundary is therefore underspecified, because a substantial share of the world's environmental pressure is being attributed to somebody.

5. Levels, Rates, and Trajectories

The second axis concerns what the analysis takes as its object. A cross-sectional correlation between two indicators across countries measures the extent to which nations that score well on one also score well on the other. A correlation between rates of change measures whether moving on one accompanies moving on the other. These are different claims, and only the second speaks to what happens when a government acts.

Level correlations across the full development spectrum are partly a restatement of development stage. Richer countries score better on most socioeconomic indicators at once, so pairwise positive correlations among those indicators are close to guaranteed before any policy interaction is invoked. Lusseau and Mancini (2019) make the dependence explicit, estimating interaction networks separately by income band and finding that goal contributions differ by country income, with limiting climate change, reducing inequalities and responsible consumption emerging as the principal obstacles. Warchold et al. (2020) reach a compatible conclusion from disaggregation, reporting that interaction patterns vary with income and region.

When the object shifts from position to movement, the balance shifts with it. Kostetckaia and Hametner (2022) find a significant negative relationship between the presence of trade-offs and observed progress among EU member states, and conclude that trade-offs shape the pace of national progress more than synergies do. Carlsen et al. (2024) push the object further, from rates to whole trajectories, and find no country path consistent with advancing all 17 goals — a result that a level-based analysis of the same data cannot produce, because it never asks the question. Linnerud et al. (2021) show the corollary that

reconciliation is possible without being automatic: clustering 117 countries within a defined sustainable development space, they find that some countries have closed far more of their competing gaps than others starting from similar positions.

Hegre et al. (2020) complicate this axis rather than confirming it, since their principal component analysis reports synergy dominance in change as well as in levels. Two features of that design temper the tension. Principal components summarise each goal from its constituent indicators, so within-goal aggregation can absorb indicator-level conflicts before the goal-level correlation is computed; and the 2000 to 2016 window closes before the reversals in poverty, hunger and inequality trends that the United Nations (2025) records. Neither observation refutes the finding. Both suggest that the analytical object interacts with aggregation level, which is a hypothesis this review states rather than settles.

6. Indicator Sets, Estimators, and the Instability of Interaction

Networks

The third axis is the least visible in published abstracts and the most damaging to the field's headline claim. An interaction network is not read off the world; it is estimated from a chosen indicator set using a chosen estimator, and both choices move the result.

Warchold et al. (2022) tested the first choice directly by assembling United Nations, World Bank and Bertelsmann Stiftung indicator sets into one database and comparing the interaction patterns each produces. The patterns are more different than similar, and the environmental goals show the largest discrepancies. Ospina-Forero et al. (2022) tested the second, noting that SDG research has largely ignored the formal network-estimation literature, then comparing estimation methods on 87 development indicators for four countries across two decades and finding that different estimators yield materially different network

structures. Bennich et al. (2020) supply the field-level corollary: across 70 studies there is no agreement on conceptual framing or assessment method.

Coverage compounds specification. Kluck et al. (2025) screened 1,511 records to 146 SDG modelling articles and found limited attention to SDGs 5, 10, 16 and 17, the goals covering gender equality, inequality, institutions and partnership. Song and Jang (2023) applied semantic network analysis to the target text and concluded that the most closely connected targets cross goal boundaries, so the 17-goal partition is a poor unit for policy design. Le Blanc (2015) had already shown that many documented biophysical, economic and social linkages appear nowhere in the explicit target wording.

Reading these together supports an inference the individual studies do not make. The goals that modelling and indicator work cover least well are the institutional and distributional ones, and those are precisely where political conflict over resource allocation concentrates. A synergy share computed over a sub-network that thins out at SDGs 5, 10, 16 and 17 is therefore likely to be biased upward relative to the full system. This is an interpretive claim about the composition of the evidence base rather than a measured bias, and it is testable: re-estimating published networks with and without the under-covered goals would show its direction and size.

7. Interaction Order and the Scale of Observation

The remaining two axes are best treated together, because both concern how far an analysis reaches from the point of observation.

Order refers to whether indirect paths are admitted. Weitz et al. (2018) demonstrated with Swedish data that adding second-order effects to cross-impact scoring reorders target priorities. Xiao et al. (2022) reported the 98.33% synergy share only after indirect interlinkages entered the model. Pham-Truffert et al. (2020) built their multiplier analysis on

the same principle, identifying targets whose outgoing influence exceeds their incoming influence. The methodological gain is real, since a policy's consequences do propagate. The interpretive caution is that in a network where direct positive ties outnumber direct negative ties, admitting longer paths multiplies sign-consistent chains faster than sign-inconsistent ones, so the indirect synergy share rises partly as a function of network density and the direct sign ratio. A high indirect synergy share is consequently weaker evidence of policy compatibility than it appears, and the strength of that effect can be estimated by permuting edge signs in a published network.

Scale refers to the unit of observation, and the evidence here is unambiguous that global averages travel badly. Zhang et al. (2022) assessed Chinese provinces using a framework grouping goals into essential needs, objectives and governance, and found trade-offs between categories in eastern provinces, synergies in parts of central and western China, and a weakening of synergies over the last decade driven by regional divergence in SDG 7 progress. Adhikari et al. (2023) found biodiversity conservation in Nepal synergistic with economic growth, gender equality and climate action while conflicting with food security, energy access and poverty reduction. Alcamo et al. (2020) identified a disconnect between national SDG planning and local implementation that generates cross-scale trade-offs, and named critical transition zones where those conflicts bite hardest. Nilsson et al. (2018), extending the seven-point interaction scale first proposed by Nilsson et al. (2016), concluded that whether a given interaction is synergistic or conflicting depends on geographical context, resource endowment, time horizon and governance capacity.

Moallemi et al. (2022) draw the practical consequence. Arguing that correlation-based and model-based interaction studies are often too technical and data-hungry for decision-makers, they offer eight recurring interaction archetypes as diagnostic and prospective tools.

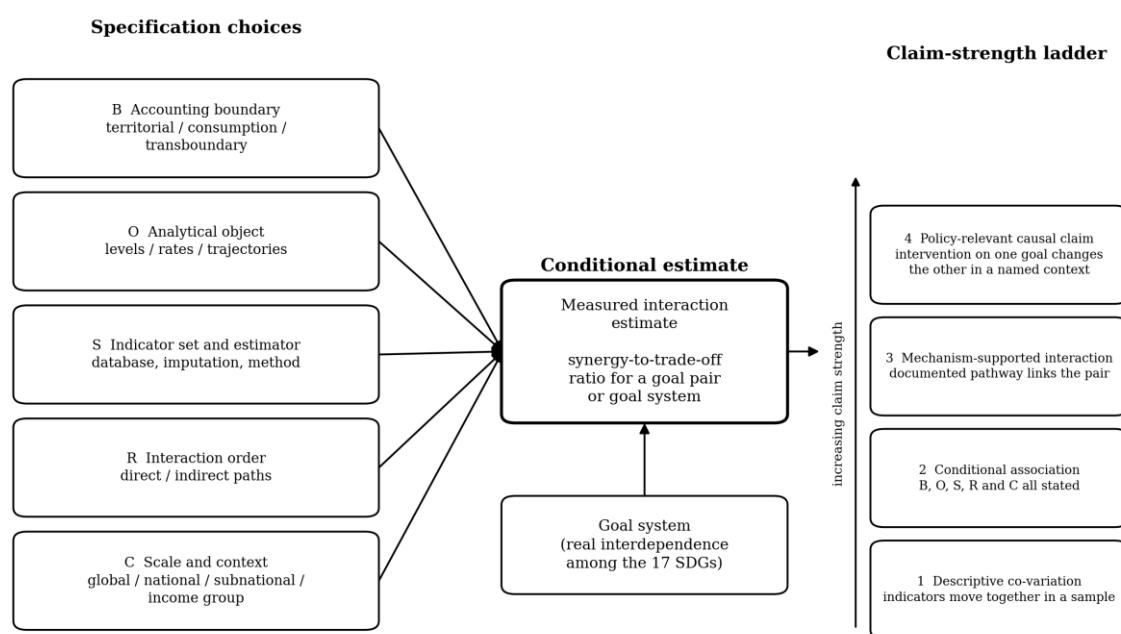
The value of archetypes in this setting is not simplification for its own sake. It is that an archetype carries its conditions with it, whereas a global average discards them.

8. A Conditional Framework for Assessing Goal Interactions

The four preceding sections support a single reformulation. A measured interaction estimate is not an observation of the goal system alone. It is a function of the system and of five specification choices: the accounting boundary B, the analytical object O, the indicator set and estimator S, the interaction order R, and the scale and context of observation C. Figure 1 sets out the resulting Conditional Interaction Assessment framework, in which those five axes condition the estimate that a study reports and determine how strong a claim that estimate can carry.

Figure 1

The Conditional Interaction Assessment framework: five specification choices, the estimate they condition, and the claim strength the estimate can support



Most published interaction estimates support rungs 1-2; conclusions are frequently written at rung 4.

Note. Specification choices B, O, S, R and C are defined in the framework section and operationalised as reporting requirements in Table 2. The ladder on the right ranks the strength of claim an estimate can carry once its conditions are known.

Five propositions state the framework in testable form.

P1 (Boundary). For the same country set and period, interaction estimates computed on territorial indicators will report a higher synergy share than estimates computed on consumption-based or transboundary-adjusted indicators, with the difference concentrated in SDGs 12 to 15 (Scherer et al., 2018; Zeng et al., 2021; Xiao et al., 2024).

P2 (Object). Estimates based on cross-sectional levels will report a higher synergy share than estimates based on rates of change, which will in turn report a higher share than estimates based on whole trajectories (Kostetckaia & Hametner, 2022; Carlsen et al., 2024).

P3 (Specification). Interaction networks are not invariant to indicator set or estimator, and the sign of a given goal-pair relation can reverse under alternative defensible specifications, most often for environmental and institutional goals (Warchold et al., 2022; Ospina-Forero et al., 2022).

P4 (Order). Admitting indirect paths raises the reported synergy share as a function of network density and the direct positive-to-negative tie ratio, so the increment attributable to indirect propagation is partly structural rather than substantive (Weitz et al., 2018; Xiao et al., 2022).

P5 (Scale). Dispersion of interaction signs across subnational units and income groups exceeds the difference between global averages reported by competing studies, so global-average claims have low transfer value to a specific jurisdiction (Warchold et al., 2020; Zhang et al., 2022; Adhikari et al., 2023).

The framework also implies a ladder of claim strength, and most published interaction statements sit lower on it than their phrasing suggests. The first rung is descriptive co-variation: two indicators move together in a sample. The second is conditional association: they move together under a stated boundary, object, specification, order and scale. The third is

mechanism-supported interaction, where a documented causal pathway links them, as in the seven-point scoring of Nilsson et al. (2016) or the archetypes of Moallemi et al. (2022). The fourth is a policy-relevant causal claim, which requires evidence that an intervention on one goal changes the other in a named context. Correlation studies establish the first rung and, when they report their specification, the second. Their conclusions are frequently written as though they had reached the fourth.

One goal pair shows the framework working. Take the relation between poverty reduction (SDG 1) and climate action (SDG 13). Under territorial indicators, cross-sectional levels, global averaging and admitted indirect paths, the pair reads as synergistic: Pradhan et al. (2017) place SDG 1 in synergy with most other goals, and Lusseau and Mancini (2019) find poverty alleviation exerting compound positive effects across the network. Shift the boundary to consumption-based accounting and the sign is no longer stable, since Scherer et al. (2018) find advances on poverty and inequality travelling with higher carbon, land and water footprints. Hold absolute limits in view and the conflict hardens further, because O'Neill et al. (2018) show that no nation currently delivers basic needs within a sustainable resource envelope. Disaggregate by income band and the relation splits, with Lusseau and Mancini (2019) identifying climate limitation as one of the principal hurdles precisely where consumption is highest. The same two goals, the same underlying data, five defensible specifications, and at least three different answers. Nothing about the goal system changed between those readings.

Table 2 turns the five axes into a reporting specification: what each study must state, which proposition the statement tests, and what a reader may conclude if the statement is absent. The specification is deliberately cheap to satisfy. It asks for no additional computation, only for the disclosure of choices already made.

Table 2*A reporting specification for Sustainable Development Goal interaction estimates*

Specification axis	What the study must state	Proposition tested	Reading when the statement is absent
Accounting boundary (B)	Whether indicators are territorial, consumption-based, or adjusted for transboundary flows, and how environmental pressure embodied in trade is treated	P1	Assume territorial; treat any reported synergy involving SDGs 12–15 as an upper bound
Analytical object (O)	Whether the estimate is computed on cross-sectional levels, rates of change, or observed trajectories, and over what period	P2	Assume levels; the estimate describes where countries are, not what happens when they move
Indicator set and estimator (S)	Which indicator database was used, how missing values were handled, which estimator produced the network, and whether alternatives were tested	P3	Treat the reported network as one draw from a set of defensible specifications, not as the network
Interaction order (R)	Whether indirect paths are admitted, to what path length, and what share of the reported synergy is attributable to them	P4	Assume direct only; if indirect paths are admitted without decomposition, discount the synergy share
Scale and context (C)	The unit of observation, the income and regional composition of the sample, and whether subnational variation was examined	P5	Assume global averaging; the estimate has low transfer value to any single jurisdiction

Note. Compiled by the author. Propositions P1 to P5 are stated in the framework section. The specification requires no additional computation, only disclosure of choices already made in the course of the analysis.

9. Discussion

What the reconciliation changes

The central empirical claim of the SDG interaction field — that synergies outweigh trade-offs — is not false. It is underspecified to the point where it cannot be falsified as stated, because the quantity it names varies with choices that studies do not consistently report. Reframing that quantity as conditional resolves the apparent contradiction between the two clusters without discarding either. Pradhan et al. (2017) and Carlsen et al. (2024) are both right about what they measured, and the appearance of conflict comes from a shared vocabulary applied to different objects.

This has consequences for how goal interdependence is theorised. The 2030 Agenda was designed as an integrated system, and Le Blanc (2015) showed early that its targets form a network denser than the Millennium Development Goals. Integration in the text does not imply compatibility in the world, and the evidence assembled here suggests that the compatibility question has no scale-free answer. The relevant theoretical object is not the interaction between two goals but the interaction between two goals under a stated set of conditions.

The finding also bears on the effectiveness debate. Biermann et al. (2017) characterised the SDGs as governance through goals — inclusive in their formation, non-binding, institutionally weak, and heavily dependent on national translation. Biermann et al. (2022), meta-analysing over 3,000 studies published between 2016 and April 2021, concluded that the political impact of the goals has been largely discursive, altering how actors talk about sustainable development while rarely reallocating resources or changing legislation. A discursive mode of influence is exactly the mode in which a specification-dependent statistic does the most damage, because the optimistic end of the range circulates as a summary while the conditions that produced it stay in the methods section.

Implications for practice

Allen et al. (2021) reviewed over 150 publications alongside the Voluntary National Reviews of 56 countries and found that advanced interlinkage methods remain largely unused in actual national planning. The barrier is capability as much as awareness, and the response should not be to press governments toward the most technically demanding estimators. It should be to pair whatever method a country can run with an explicit statement of its five specification choices, and to prefer condition-carrying tools where capacity is limited. The archetypes of Moallemi et al. (2022) and the seven-point contextual scoring of Nilsson et al.

(2016) are more defensible inputs to a national plan than an imported global correlation, because they force the analyst to name the context in which the interaction is claimed to hold.

For agenda design after 2030, two points follow. Song and Jang (2023) show that the tightest target communities cross goal boundaries, and the six transformations proposed by Sachs et al. (2019) organise the agenda around delivery systems rather than goal numbers. Both suggest that the 17-goal partition, whatever its political value, is a weak analytical unit, and that successor architectures would gain by defining the units of coordination around the systems that actually produce the outcomes. The Independent Group of Scientists appointed by the Secretary-General (2023) argues that incremental and fragmented change is insufficient and identifies governance, finance, individual and collective action, science and capacity as levers of deliberate transformation. Those levers act on the conditions that this review identifies as decisive, which is a reason to treat conditions rather than correlations as the target of policy design. The United Nations (2025) reports real gains — universal electricity access reached in 45 countries, elimination of neglected tropical diseases in 54 — alongside a pace of change insufficient to meet the goals by 2030. Both halves of that assessment are consistent with a system whose interactions are conditional rather than fixed.

A specification-dependent quantity also creates an incentive that the field should name. Where several defensible designs are available and only one number is reported, the reported number will tend to be the one that supports the argument the study is making, without anyone acting in bad faith. Journals and assessment bodies can close most of that space at low cost by asking authors to state their five choices and, where feasible, to report the synergy share under one alternative specification. A study that shows its result surviving a change of boundary or object has said something that a single matrix cannot say.

Limitations

This is an integrative review, and its boundaries are those of the form. It applies no formal quality appraisal and makes no claim to exhaustive coverage of a literature that Bennich et al. (2020) already showed to be large and fragmented. The coding behind Table 1 is a structured reading by a single author, not a double-coded protocol, and other readers could place particular studies differently on the object or order axes. The five propositions are derived from comparison across published designs and remain untested here; the paper offers no re-estimation of any dataset. The corpus skews toward globally scaled quantitative work published in a limited set of English-language outlets, which under-represents case-based and non-English scholarship where context-specific interactions are most likely to be documented. Claims about why indirect-path inclusion raises the synergy share, and about upward bias from thin coverage of SDGs 5, 10, 16 and 17, are interpretive inferences that the cited studies support but do not themselves state.

Future research

The propositions are designed to be cheap to test. P1 and P2 require only that an existing indicator panel be re-analysed under paired specifications — territorial against consumption-based, levels against rates — with the synergy share reported for each. P4 can be examined by sign-permutation on published networks, isolating how much of the indirect synergy share follows from density alone. P3 and P5 call for a multi-specification sensitivity study of the kind that Warchold et al. (2022) and Ospina-Forero et al. (2022) began within their own axes but that no study has yet run across axes simultaneously. Beyond hypothesis testing, the more consequential work is institutional: developing a short reporting convention for interaction studies, along the lines of Table 2, and embedding it in the guidance that shapes Voluntary National Reviews. Kluck et al. (2025) show that the modelling base still neglects

the goals where distributional conflict lives, and closing that coverage gap would do more for the credibility of interaction evidence than another global correlation matrix.

10. Conclusion

The literature on Sustainable Development Goal interactions has been reporting a stable finding that turns out to depend on how the question is asked. Synergy dominance emerges from territorial indicators, cross-sectional levels, global averages and networks that admit indirect paths. Structural conflict emerges from consumption-based accounts, rates and trajectories, subnational units, and analyses that hold absolute biophysical limits in view. Both bodies of evidence are sound within their own terms, and the contradiction between them dissolves once the measured synergy-to-trade-off ratio is treated as conditional on specification rather than as a property of the goal system.

What this review closes is the interpretive gap between two literatures that had stopped reading each other. What it leaves open is the empirical size of each conditioning effect, which the five propositions are written to make testable. The practical consequence is immediate and does not wait on those tests. An interaction claim that does not state its accounting boundary, its analytical object, its indicator set and estimator, its interaction order and its scale cannot be interpreted by a reader, and should not be carried into a national plan as though the goal system had been shown to cohere.

Declarations

Funding. This research received no external funding.

Conflicts of interest. The author declares no conflict of interest.

Ethics statement. This study is a review of previously published literature and intergovernmental assessments. It involved no human participants, no animal subjects and no primary data collection, and therefore required no ethical approval.

Data availability. No new data were generated. All sources analysed are published works listed in the reference list and identified by digital object identifier or public repository address.

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Hashtags:

#SDGs #GlobalGoals #2030Agenda #SustainableDevelopmentGoals #GoalInteractions
 #Synergies #TradeOffs #PolicyCoherence #IntegratedAssessment #U7YJournal #U7Y
 #AcademicResearch