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Editorial

Policy relevance of IPCC reports for the Sustainable Development Goals and beyond

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ABSTRACT

Climate change and sustainability linkages provide opportunities to develop and implement synergistic strategies for climate actions and achieve Sustainable Development Goals (SDGs). Thus, we synthesize the coverage of SDGs in the IPCC's fifth and sixth assessment reports at a target level. Based on this reflection, we propose the seventh assessment cycle of the IPCC to cover SDGs holistically, using a systematic approach, breaking the Working Group silos, and contributing to the post-2030 agenda.

In the early stage of the seventh assessment cycle (AR7) of the Intergovernmental Panel on Climate Change (IPCC), a timely reflection on the previous IPCC reports is beneficial to enhance the policy relevance of the AR7 reports. The need to tackle climate change and sustainability challenges jointly is the subject of a lively debate (United Nations, 2024). Advancing this notion, we synthesize the coverage of the 17 Sustainable Development Goals (SDGs) and 169 associated targets in the IPCC's fifth and sixth assessment reports (AR5 & AR6), following an in-depth text analysis of linkages between the SDGs and climate change at a target level, considering climate change impact, adaptation, and mitigation (Pradhan et al., 2024a). We present a demanding yet realistic route forward for the AR7 reports to embrace the challenge of a holistic assessment of climate change and sustainability policies, consistent with the AR7 ambition to help societal decision-making by providing action-oriented insights.

1. Coverage of SDGs in IPCC reports

SDG coverage in the AR5 and AR6 reports is measured by systematically sampling the occurrence of keywords referring to SDG targets (see Text S1 for Materials and Methods). It has increased from AR5 to AR6 [Fig. 1 (left), S1–S3], likely due to the adoption and the growing understanding of the SDGs, the Paris Agreement, and the beginning of

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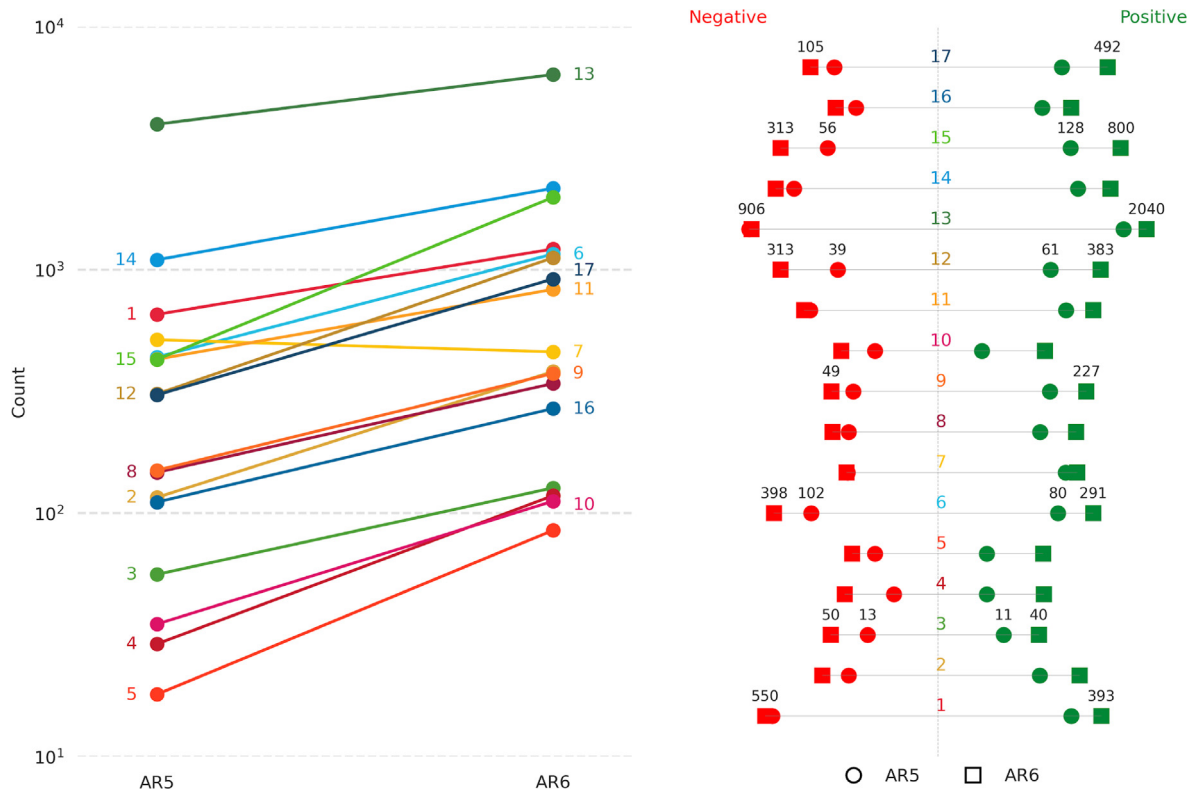

Fig. 1. References to Sustainable Development Goals (SDGs) increased between the IPCC's fifth and sixth assessment cycles (AR5 & AR6). Left panel: The *y*-axis depicts the occurrence of references to 17 SDGs (note the log scale), represented by the numbers in colour and measured based on the keywords related to SDG targets. Except for SDG 7 (clean and affordable energy), references to SDGs in AR6 outnumber the AR5 references. See Figs. S1–S3 for the occurrence of references to SDGs and targets mentioned in each IPCC report. Right panel: the sentiments of the referred associations between climate change and sustainability are slightly more often positive than negative. The length of the lines depicts the occurrence of the text related to SDG targets (on a log scale), and only five or more words associated with these sentiments are considered (see Text S1 for Materials and Methods).

the AR6 cycle in 2015. AR5 and AR6 mention the keywords related to all 17 SDGs and most of their underlying targets (128 in AR5 and 143 in AR6), acknowledging linkages between climate change and sustainability. However, the reference to these linkages is not equally distributed among the SDGs, although the IPCC reports comprised chapters entitled Sustainable Development (Birkmann et al., 2022; Hurlbert et al., 2022; Roy et al., 2018). In AR6, references range from ~100 for SDG 5 (gender equality) to ~6,300 for SDG 13 (climate action). Also, SDG 14 (life below water) and 15 (life on land) are referred to at least ~2,000 times. References to the underlying targets range from zero to ~3,100. This coverage provides meaningful information for developing strategies to address climate and sustainability synergies. SDGs are covered the least in the contributions from Working Group (WG) I (the physical science basis) and the most in WG II (Impacts, adaptation, and vulnerability) (Fig. S1–S3). A lower SDG coverage in WG I is to be expected. SDGs 7 (clean and affordable energy), 8 (decent work and economic growth), 12 (responsible consumption and production), and 17 (partnership for the goals) are most frequently mentioned in WG III (Mitigation of climate change) contributions.

The many references to SDGs 13, 14, and 15 highlight the reports' focus on climate change, ocean acidification, sea level rise, land-based mitigation, and ecosystem impacts of climate change, consistent with the IPCC mandate. The ten most frequently mentioned SDG targets (appearing at least 500 times) also cover other SDGs, e.g., Targets 1.1 (eradicate extreme poverty), 6.4 (increase water-use efficiency and ensure freshwater supplies), and 12.3 (halve global per capita food waste). This demonstrates close linkages between climate change impacts and actions (i.e., adaptation and mitigation) across various SDGs. SDG 11 (sustainable cities and communities) is mentioned ~800 times in AR6, a linkage that is also included in the adopted Scoping Outline of the AR7 Special Report on Climate Change and Cities (IPCC, 2024). Apart from SDG 5, the least frequently mentioned goals are SDGs 3 (good health and well-being), 4 (quality education), 10 (reduce inequalities), and 16 (peace, justice, and strong institutions), with less than 300 references in the AR6 reports. In this cycle, 56 targets are referred to less than five times, also belonging to SDGs 1, 2, 7, 8, and 15. It can be argued that these relatively poorly mentioned goals and targets also have linkages to climate change impacts and policies, warranting systematic evaluation in the AR7 cycle. Also, the understanding of these linkages and their literature is growing. For example, Scopus provides over 3,000 documents published since 2015 related to climate change and the five least frequently mentioned goals: SDGs 3, 4, 5, 10, and 16. In AR7, an opportunity exists for systematically assessing the linkages between climate action and sustainability across a broad spectrum of societal goals and targets.

In the IPCC reports, the framing of climate change and sustainability association varies across SDGs between negative and positive, identified using sentiment analysis based on words with positive and negative connotations [Fig. 1 (right), S4, and S5; see Text S1 for Materials and Methods]. The negative sentiments mainly raise the alarm about climate change impacts. Positive sentiments are primarily associated with the sustainability co-benefits of climate change adaptation and mitigation. The AR5 and AR6 reports show more positive than negative sentiments for ten and fourteen SDGs, respectively, suggesting an increased emphasis on climate change solutions. The existing literature highlights the overall negative impacts of climate change on SDGs and some trade-offs between climate goals and SDGs (Halsnæs et al., 2024; Singh et al., 2019). However, our sentiment labelling does not specify climate change and sustainability linkages as synergies or trade-offs. Therefore, we conducted an in-depth manual text analysis to identify synergies and trade-offs between climate change and sustainability, as mentioned in the AR5 and AR6 reports.

Fig. 2. Climate change and sustainability linkages in AR5 and AR6, compiled according to climate change impact, adaptation, and mitigation. We consider positive linkage to be a synergy and negative linkage to be a trade-off based on the synthesized reasons behind the linkages between climate change and sustainable development goals (SDGs). An SDG target can also be both positively and negatively linked with climate change. Figs. S6–S9 present these linkages with different mechanisms for climate impact, adaptation, and mitigation. Table S1 provides the detailed reasons behind these synergies and trade-offs and lists the full names of the targets. Abbreviations used are economic (eco.), infrastructure (infra.), communities (comm.), responsible consumption and production (respon. con. and prod.), justice (just.), and institution (instit.).

2. Synergies and trade-offs between climate change and sustainability

Understanding the mechanisms behind climate change and sustainability linkages enables leveraging synergies and tackling trade-offs to meet climate and sustainability goals. To give direction to the AR7 assessment, we distil these mechanisms from the AR5 and AR6 reports based on the most frequently compiled reasons for synergies and trade-offs between climate change and SDGs (Fig. 2, S6–S9, Table S1). Here, we compile synergies and trade-offs associated with climate change impact, adaptation, and mitigation.

Climate change is negatively linked with most SDGs, exacerbating their progress (Fig. 2, S6). These negative linkages are associated with increased temperature, changing precipitation patterns, extreme weather events, sea level rise, and ocean acidification, leading to damaged assets and life loss, impaired food and water security, and reduced development potential. Tackling these climate change impacts is central to most SDGs. AR5 and AR6 identify negative climate change impacts on 59 targets, fewer than other studies (Fuso Nerini et al., 2019; United Nations, 2024). The WG II contribution to AR5 and AR6 reports climate change impacts on ecosystems and human systems (IPCC, 2022). Here, climate change impacts on three or fewer targets are covered for SDGs related to education, clean energy, infrastructure and innovation, inequality, responsible consumption and production, and partnerships for the goals (Fig. 2).

All SDGs, with 82 out of 169 targets, are synergistic to climate change adaptation (Fig. 2, S7). These synergies can be attributed to actions related to building adaptive capacity, nature-based solutions, climate-resilient development, Indigenous and local knowledge, and disaster risk management, contributing to meeting multiple SDGs at a time. Vice versa, for many targets, e.g., eradicating extreme poverty (Target 1.1) and implementing social protection systems (Target 1.3), their achievement supports climate change adaptation, leading to synergies. However, climate change adaptation can also be negatively linked with some SDGs, which are observed for 28 targets. These negative linkages include increased emissions, maladaptive practices, and unintended consequences of adaptation actions. For example, relocating people living in vulnerable urban slums far from work (often in the informal sector) may serve the goal of reducing exposure to climate extremes but may result in adverse consequences and social conflicts (Caretta et al., 2023).

Climate change mitigation has synergies with all SDGs (shown for 68 targets) and trade-offs with some (comprising 33 targets) (Fig. 2, S8). The synergies involve social, economic, and environmental co-benefits of mitigation actions. These actions include sustainable land and forest management, energy transition, behaviour changes, mobility transition, and circular, low-carbon, and bio-based economy. Also, achieving many SDGs contributes to (or is motivated by) climate change mitigation, e.g., sustainable food production (Target 2.4), increasing renewable energy (Target 7.2), implementing sustainable consumption and production framework (Target 12.1), halving food loss and waste (Target 12.3), and conserving and restoring ecosystems (Target 15.1). However, mitigation actions can have unintended consequences, resulting in trade-offs with some SDGs. For example, increased biomass and biofuel use can either directly reduce the available food for human consumption (e.g., sugarcane and maize in biofuel production) or lead to competition for resources to produce food (e.g., land

and water resources), potentially affecting food security (Roy et al., 2018). Also, conventional ways to achieve SDGs, e.g., reducing poverty (Target 1.2) and sustaining economic growth (Target 8.1), could be negatively linked with climate change mitigation, including rebound effects (Bruckner et al., 2022).

Implementing climate actions also requires generating enabling conditions and tackling existing barriers, such as governance arrangements, institutions, and infrastructure (Fig. S9). AR5 and AR6 highlight cross-national partnerships and agreements, climate financing, (sub-)national laws, policies, institutions, and partnerships, and digitization and data management as enablers or barriers to climate actions. Depending on the political economy context, these conditions can support or hinder the achievement of many SDGs (Hallegatte et al., 2024). For example, considering climate change issues in economic decisions and public finance strengthens governments' ability to procure, manage, and allocate revenues of these investments more effectively (Dodman et al., 2023). However, climate policies such as carbon taxes that fail to account for the specific socio-economic context might disproportionately burden low-income households, exacerbate inequality, and potentially lead to public resistance and reduced compliance (Roy et al., 2018).

3. IPCC AR7: The road ahead

While a focus on climate change is the prime mandate of the IPCC, emphasizing and providing scientific evidence on the context-specific linkages between climate change and sustainability strongly supports the development and implementation of effective policies and interventions. Doing so can achieve a more balanced approach to climate and sustainability goals, facilitating coherent actions that reflect the complexity of these challenges.

Our proposal for holistic coverage of SDGs and understanding the mechanisms behind climate change and sustainability linkages holds the potential to make the upcoming IPCC reports more policy-relevant. Doing so will also stimulate more research on SDG and climate change linkages, which will be timely catalysts for accelerating SDG progress in its final years. Beyond assessing the co-benefits of climate actions (IPCC, 2022), systematically capturing its synergies and trade-offs with sustainability goals can support balancing multiple interests during policy design and implementation (Pradhan et al., 2024b). The clear focus on sustainable development in the approved outline for the Special Report on Climate Change and Cities provides an early indication of the opportunity to systematically assess climate change and sustainability linkages in the AR7 cycle (IPCC, 2024). Here, the growing understanding and literature on SDG linkages is an opportunity. Three complementary approaches further support our vision for the IPCC AR7.

First, a holistic understanding of climate change and sustainability linkages requires breaking the silos between the IPCC WG domains. SDGs are intrinsically linked with climate change and its impact, adaptation, and mitigation, which should be reflected in each WG's contribution to the Assessment reports. WG I could link climate change trends with SDGs, followed by an assessment of the impacts of climate change on SDGs in the WG II report, including synergies and trade-offs between adaptation actions and SDGs. Linkages of mitigation actions and SDGs could be addressed in the WG III report. The Special Report on Climate Change and Cities, bringing the three WG domains together, is a venue for cross-cutting work on the SDGs. The joint scoping meeting for the Assessment Report across all WGs is a way forward in this direction, and its momentum should be continued by consistently reflecting on the SDGs in all three WG reports, for instance, by dedicated cross-WG coordination and a further elaboration in the AR7 Synthesis Report.

Second, a systematic approach to the assessment of linkages between climate change and sustainability can be supported by complementing the manual literature assessment with the use of machine learning, text mining, and artificial intelligence. Beyond mapping climate change and sustainability linkages, systematically capturing solutions to leverage synergies and tackle trade-offs of climate actions on SDGs would make the reports more action-oriented (Montfort et al., 2024). Also, understanding the social, economic, and environmental conditions required for climate actions and the conventional SDG implementation ways that undermine climate actions is crucial (Bruckner et al., 2022; Soergel et al., 2021).

Third, the AR7 cycle also informs the future sustainability agenda beyond 2030, which covers the era following the SDGs. Suppose there is a follow-up sustainability agenda after the SDGs. In this case, timely background preparation is required to make this post-2030 Agenda sufficiently science-based. For this, scientific evidence generated during the AR7 cycle on climate change and sustainability linkages would be extremely timely as there might be unknown, indirect linkages we have not discovered yet. Learning from climate communities is valuable for reforming the SDGs by making them dynamic with periodic revisions like Nationally Determined Contributions (NDCs) for climate mitigation (Biermann et al., 2023).

Options exist to realize the IPCC's ambitions to enhance further its policy relevance by accounting for multiple climate change and sustainability linkages. SDGs provide a sustainable framework for regional, national, and international policies. Conversely, these policies are challenged to balance the multiple objectives of SDGs and climate change adaptation and mitigation actions. A way forward for this is to cover SDGs holistically and reflect the mechanisms behind climate change and sustainability linkages, using a systematic approach, breaking the WG silos, and contributing to the post-2030 agenda.

CRediT authorship contribution statement

Prajal Pradhan: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Sushobhan Joshi:** Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Kshitij Dahal:** Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Yuanchao Hu:** Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Daya Raj Subedi:** Conceptualization, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. **Muhammad Panji Islam Fajar Putra:** Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Shrijana Vaidya:** Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Laxmi Prasad Pant:** Formal analysis, Writing – original draft, Writing – review & editing. **Shobhakar Dhakal:** Conceptualization, Writing – review & editing. **Klaus Hubacek:** Conceptualization, Writing – review & editing. **Maheswar Rupakheti:** Conceptualization, Writing – review & editing. **Debra C. Roberts:** Conceptualization, Writing – review & editing. **Bart van den Hurk:** Conceptualization, Writing – review & editing.

Declaration of Generative AI and AI-assisted technologies in the writing process

We disclose using AI-assisted technologies to polish the language in Supplementary Materials.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Prajal Pradhan is a member of the Editorial Board of Resources, Environment and Sustainability. Yuanchao Hu is a member of the Early Career Editorial Board of Resources, Environment and Sustainability. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Text S1. Materials and Methods
Figs. S1 to S9
Tables S1
References

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.resenv.2025.100192.

Data and materials availability

Search query data for mapping SDGs is taken from the cited paper. The corresponding author will share other data reported in this paper upon request. This paper does not report the original code. Any additional information required to reanalyze the data reported in this paper is available upon request.

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