

## **A causal systems model to understand synergies and trade-offs among SDGs**

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### ***Extended Abstract***

Achieving the Sustainable Development Goals (SDGs) by 2030 requires assessing interactions, monitoring progress, and designing policy from a systems perspective. Efforts towards achieving a goal or target can often create synergies and thus leverage progress towards achieving others (Sachs et al. 2019). Hurdles also emerge given trade-offs among social, economic, and environmental aspects in persisting development paths. Past research has explored interactions among SDGs using quantitative approaches (Kroll, Warchold, & Pradhan, 2019; Lusseau & Mancini, 2019; Pedercini, Arquitt, Collste, & Herren, 2019; Pradhan et al., 2017; Zhou & Moinuddin, 2017), qualitative frameworks (Nilsson et al., 2016; Sachs, Schmidt-Traub, Mazzucato, et al., 2019), and expert knowledge (e.g. Fuso Nerini et al., 2019). However, mixed-methods that go beyond first order interactions and consider feedback processes are lacking.

We create a causal SDG systems model by combining a correlation analysis of SDG indicator data with literature research and expert knowledge. The influence of targets and goals on the overall objective of achieving the SDGs is assessed. Overall, we find more levers than hurdles, with SDGs 3 (*Good Health and Well-being*), 5 (*Gender Equality*), and 17 (*Partnerships for the Goals*) showing the most leverage potential, while SDGs 10 (*Reduced Inequalities*) and 16 (*Peace, Justice and Strong Institutions*) are shown to create potential hurdles. However, influence at target level varies greatly within each goal, with the top three leveraging targets (5.5, 17.8, 17.6) and hurdle targets (16.8, 10.6, 15.5) representing five different goals. By conducting a sensitivity analysis to assess the dependency of findings on SDG target weights in the model, we find that the results are robust regarding this specification. Likewise, a regional analysis of continents and income groups shows that the SDG levers and hurdles are

globally representative. At continent level, only Africa contributes less to SDG hurdles, indicating fewer trade-offs in relation to SDG progress.

The novel SDG systems model contributes several key findings. First, we use a data-driven approach to go beyond second-order effects of SDG interactions (Weitz et al., 2018) and capture complex feedback loops. Model results vary from the correlation analysis, with only SDGs 10 and 16 identified as potentially acting as systemic hurdles in both cases. Second, we show that most countries share both challenges and opportunities for achieving the 2030 agenda, with relatively low variation among continents and income groups. Third, our results highlight the crucial role of gender equality [SDG 5] and international cooperation [SDG 17] for achieving *a sustainable world*.

Since the model relies on underlying historic SDG indicator data, results may shift along with development pathways. The causal systems model should allow for increased systemic monitoring of SDG progress and can be adapted to regional or country scales. We encourage further comparative SDG systems model research especially at these scales, since a more thorough understanding of causal relations may allow for more detailed and complex interconnections. Persisting hurdles among targets must be recognized and overcome in the long-term, while levers may multiply benefits towards achieving the SDGs.