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Editorial: *Sustainametrics*—Envisioning a sustainable future with data science

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Editorial on the Research Topic
Sustainametrics—Envisioning a sustainable future with data science

What is *sustainametrics*?

Sustainability study provides a roadmap to a better future. The global community is seeking a way to protect the people and the environment while supporting our economic prosperity, embodied by the UN Sustainable Development Goals (SDGs). Regrettably, however, progress toward the sustainable future has lagged through the pandemic; worse, there are some early signs that governments are reducing financing toward reaching the SDGs in the post-COVID era.

Today, researchers have access to an unprecedented amount of data in the field of sustainability, and data science may hold the key to changing this tide. We can urge immediate actions for the global community by objectively analyzing the environmental, social, and economic progress toward SDGs—to open a new way to a sustainable future.

It is time for us, researchers and practitioners, to reinvigorate global strides toward a sustainable future through coordinated efforts to utilize data in analyzing every aspect of sustainability. What is particularly needed today is the quantitative analysis of global development based on the empirical development of sustainability theory and observation. With this approach—which we named *sustainametrics*—academics may be able to present a viable path to a sustainable future (Figure 1).

The *sustainametrics* approach

Pioneers have long strived to pursue *sustainametrics* over the past generations, even before the advent of data science. We can trace the origin of *sustainametrics* to the *Essay on the Principle of Population* by Thomas Robert Malthus (1798), where Malthus argued that exponential population growth would eventually outpace linear agricultural production, leading to famine or war. This argument had become the underlying proposition of the famous report *The Limits to Growth* by the Club of Rome (1972), which showcased the groundbreaking application of the system dynamics in the field of sustainability.

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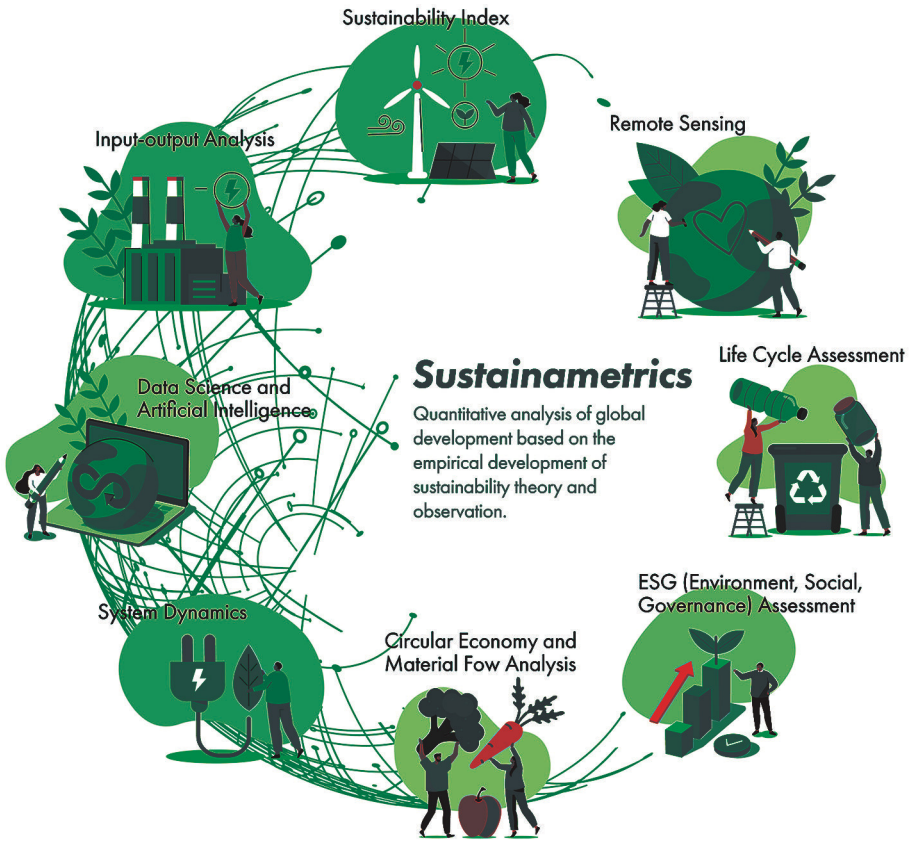

FIGURE 1
Sustainametrics-envisioning a sustainable future with data science.

Recent developments in data science have provided academics and practitioners the ability to analyze the progress of sustainable development more holistically and swiftly than these pioneers—a critical ability in a rapidly changing post-COVID landscape. Artificial intelligence (AI) is already proving useful in assessing the environmental impact from remote sensing data. Machine learning algorithms are being deployed to track poverty in real-time from alternative data including remittance. Further, existing quantitative methodologies, such as life cycle assessment (LCA), input-output analysis, material flow analysis, not to mention system dynamics, are also benefiting greatly from enhanced access to data supported by applied AI.

About this Research Topic

There are challenges to overcome toward establishing sustanametrics as an academic field. Some practitioners are still skeptical of the usefulness of data science in the actual world due to the incompatibility, uncertainty, and gaps in real-life data; others have suspicions about the capabilities of simple analytical models on understanding the inherently indeterminate real-life consequences. However, revealing new insights and gaining experience to bolster confidence is not enough. As Okui and Takeda conclude, catalyzing civic action through disclosure of what sustainametric professionals see and understand that other do not is essential to making real progress. Therefore, we see the need to bring together the wisdom on how data science and other quantitative methodologies can push the sustainability development forward now more than ever.

Our first collection on sustanametrics has gathered the 15 most insightful and inspiring contributions from like-minded researchers worldwide that is truly worthy of a start of a new academic field.

Keeley, Chapman et al. provides a closer look at the ESG metrics, which plays a crucial role as an enabler of investment strategies that consider ESG factors. The study confirms that ESG investments can be expected to provide stable and high returns especially over the long term. However, the study also identifies that there is significant divergence among the different ESG metrics in the elements assessed, and the weak correlation of ESG ratings of widely used ESG metrics.

Plugge proposes a new set of metrics that provides companies with a tool to measure and report on progress toward a circular economy. The proposed set of metrics is composed of quantitative risk and hazard metric combining chemical exposure and environmental health hazard within the supply chain. Similarly, Betts et al. propose a new set of metrics to measure the circularity and impact of reusable packages in supply chains, by connecting the existing research on circular economy metrics with reuse strategies in supply chains. The authors categorize these metrics as product-level or system-level based on the level of detail they incorporate and demonstrate their application with a case study from an omnichannel retail company.

Keeley, Li et al. calculates the cumulative ESG ownership based on the ESG scores of invested companies, the total market price of invested companies, and the investor history portfolio report. The study identifies the major players in the field, differences in the trend by type of investor and country and expands the study by investigating the relation between calculated ESG ownership score and investor's ESG commitment and ESG performance.

Aboginije et al. measure the life-cycle sustainability performance of a waste management system in South Africa and shows that the South African construction industry is hitherto to fully adopt and implement a sustainable waste management system for effective waste minimization, although the overall performance shows that the waste sectors are thriving and improving in their approach to waste management. Rinawati et al. focuses on LCA studies of hydrogen-based power generation and provide thorough review of the technological and methodological choices made in hydrogen-based power generation LCAs. The study points out that no studies that addressed social impact were identified through the systematic review and assert the importance of applying social LCA methodology to the research and development process for understanding the future impact of the hydrogen-based power generation more holistically. Zulfhazli et al. shed light on techno-economic aspect of hydrogen production from power generation through comparatively investigating the energy sources, feedstocks, and various methods of hydrogen production in detail.

Schubert et al. illustrates the complementary value of multidisciplinary inferential models in informing large predictive models by applying structural equation modeling to investigate the relationships that delineate the underlying mechanisms for energy consumption behaviors in the case of private transportation.

Kitsuki and Managi proposes a framework for weighting priority for the multidimensional domains of slum development from the viewpoint of residents and demonstrate this approach by accessing residents' needs for slum development focusing on India with employing a large-scale questionnaire data. The study sheds light on the importance of information on marginal utilities of each domain, as well as satisfaction scores for designing sustainable path for slum development.

Jin and Ialnazov also investigates the elements that are important for sustainable rural development, focusing on house-hold level solar energy projects in rural and remote areas. The study applies analytic hierarchy process and fuzzy comprehensive evaluation method to assess sustainability performance of the solar energy projects conducted in Jinzhai County, China.

Sakaguchi and Fujii investigate the impact of renewable energy on wholesale electricity prices. The result of the study implicates that compared with solar power, wind power has stronger merit order effect, which is the price reducing effect of renewable energy on wholesale electricity prices. Hao et al. sheds light on the solar PV locations' hazard risks at a national scale employing satellite data. The study investigates the risks stemming from landslides and floods for the existing solar PV power plants and finds that the shares of medium and large-scale solar PV power plants found in areas where landslides and floods are likely to occur are about 8.5 and 9.1% respectively in Japan.

Edwards et al. provides thorough review of satellite data application in the study and practice of sustainable energy system development and shows that satellite data are increasingly applied to a wide range of energy issues with varying information needs, from planning and operation of renewable energy projects, to tracking changing patterns in energy access and use, to monitoring environmental impacts and verifying the effectiveness of emissions reduction efforts. Similarly, Kazawa et al. emphasizes the effectiveness of using satellite data for assessing urban environment and urban design and understanding industrial clusters. The study examines whether nighttime light can be a proxy for building height and finds a high correlation between night light and building height.

Finally, Okui and Takeda revisit the measure of development and provide a critique of *sustainametrics*. Following Heidegger's and Arendt's threads of thought, the authors stress that any measures of development must be fundamentally grounded in disclosure through speech and action in the public realm; thus if the discipline of *sustainametrics* is to devise and propose measures for the sustainability of the world, then it must be conscious of the limit and prevent the reproduction of its thoughtless adoption by constantly exposing its outcomes to the scrutiny of political debate in the public realm.

Author contributions

ST conceptualized sustainametrics. AK, TG, and SM made a substantial, direct, and intellectual contribution to the concept. All authors contributed to the editorial and approved it for publication.

Conflict of interest

TG was employed by Industrial Ecology Consultants, a private consultancy firm of his own.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note