



Backstory

Pursuing multifaceted-disciplinarity to enrich the future of justice in sustainability science

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Although sustainability issues disproportionately affect disenfranchised populations, justice considerations are often left to social scientists in sustainability research. As early-career researchers pursuing doctoral degrees in diverse disciplines focusing on sustainability, we reflect on the unintentional exclusion of justice in sustainability research. Building on our individual and collective research experiences, we propose a critical *multifaceted-disciplinary* perspective, advocating for the holistic creation of interdisciplinary academic teams involving scholars from diverse racial, social, cultural, and economic contexts.

Above image: From left to right and top to bottom: Vishal Sharma, Sarah H. Roney, Olanike Olaomo, Oliver Chapman, and Carlos A. Fernández are graduate fellows. Michael Chang is the associate director of the Brook Byers Institute for Sustainable Systems at Georgia Institute of Technology.



By embracing multifaceted-disciplinarity, we can step toward establishing and nurturing spaces that enrich justice considerations in sustainability science, forming a more comprehensive understanding of sustainability predicaments and building sustainable and humane futures for all.

INTRODUCTION

Sustainability is a fundamental concept when devising just and ethical considerations of the value and use of nature and the responsibilities for future generations. However, considerations of justice in mainstream sustainability research remain limited, especially in application or practice. Many scholars, including us, have noticed that sustainability professionals often sideline the critical discussions on justice (e.g., intergenerational equity and environmental racism), undermining efforts to nurture truly sustainable futures for all.¹ Neglecting justice considerations in sustainability research excludes the well-being of current and future generations by compromising their resource needs and exacerbating existing inequalities among marginalized communities with limited infrastructure impacted by climate change. Pathways to sustainable futures should be grounded in principles of justice.

We came together as graduate fellows in the Brook Byers Institute for Sustainable Systems at Georgia Institute of Technology. This unique program provided us with the opportunity to learn interdisciplinary perspectives on sustainability, equipping us to become future sustainability leaders. We represent a diverse group situated in five disciplines: computer science, biology, sociology, public policy, and engineering. We also bring a global perspective to sustainability challenges, as we come from five continents: Asia, North America, Africa, Europe, and South America. Despite our backgrounds, we share a common goal: addressing sustainability issues through our research. Our co-authorship of this paper represents our commitment to advancing sustainability research. Combining our diverse opinions, perspectives, knowledge, and ideologies on sustainability and justice, we aim to create a richer conversation in sustainability science. Through this commentary, we reflect on our own journey of connecting justice and sustainability discourses. Although positioned 30 years after the recognition of a climate crisis and having inherited the issues of previous generations, we still remain optimistic for our own careers in sustainability research and a sustainable world we hope to leave for generations to come.

Across many sustainability disciplines, a *just sustainability* framework can be used to integrate a justice lens in sustainability research. Just sustainability acknowledges that disenfranchised, historically colonized, or systematically oppressed populations with the least socioeconomic and political power are often the most vulnerable to environmental crises.² Its proponents advocate for centering sustainability on equality, i.e., all individuals having equal rights and equity, i.e., all individuals having access to resources needed to thrive within and across societies. Just sustainability considers the following: (1) sustainability issues are distributed across spatial and temporal scales, i.e., they do not occur right away but are removed from the time and place of their cause and are often uncertain and ambiguous; and (2) not all stakeholders, including those traditionally marginalized, non-human life, and future generations, participate equally and thus might not have agency and ability to influence the decisions impacting them.

Although the just sustainability lens can be helpful for incorporating justice in sustainability science, it remains underutilized.³ Furthering just sustainability thinking within sustainability research requires a paradigm shift, breaking the culture of silence and asking critical questions. As Nardi and Ekbia⁴ stressed, “Just asking a good question can be a powerful act ... [we need to] pursue questions that challenge the mainstream ... if we stop before we start, we cannot move forward.” One approach involves holding frequent *climate killjoy talks*.⁵ In this article, we embrace this spirit of critical inquiry to ask meaningful, productive, and fundamental questions that could advance just sustainability efforts within and across disciplines. We ask our readers to pause and critically reflect on the potential ways to address the questions from their standpoints as sustainability scholars in diverse academic disciplines to take the conversation forward.

SUPPORTING INTERDISCIPLINARITY

Deploying a just sustainability lens requires interdisciplinarity or the intellectual and intentional coalition of practitioners of diverse disciplines. Teams must work to include scholars of diverse disciplines and transcend disciplinary boundaries altogether. This transcendence requires moving beyond the limitations imposed by traditional academic silos and fostering a space where scholars can contribute their unique knowledge and expertise. These interdisciplinary collaborations are needed to integrate knowledge and skills to address the complex, real-world, and vast sustainability predicaments. For example, achieving the United Nations Sustainable Development Goals requires a multifaceted approach integrating knowledge and skills from various fields, such as academia, industry, management, and government.

Interdisciplinarity is championed by many prominent organizations, including the National Science Foundation, the National Academy of Sciences, and the European Advisory Board. However, reality sometimes falls short of this ideal. Often, in an interdisciplinary team,

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stakeholders from two or three closely related disciplines may end up collaborating.⁶ When included, non-technical disciplines, such as arts and humanities, are often only considered to fill the gaps created by other “technical” disciplines.⁷ Links across disciplines, especially between technical and non-technical fields, need to be strengthened by establishing spaces that bring together different epistemic traditions, encouraging interdisciplinary collaborations.

Higher education institutions, where many sustainability researchers are, are in the foreground of vital knowledge-making. To foster true interdisciplinary collaboration, universities can establish and nurture spaces that actively bring together diverse epistemic traditions. These spaces should encourage collaboration across disciplines, especially between technical and non-technical fields. Establishing such spaces is crucial because complex sustainability issues of climate change, forced migration, and biodiversity loss cannot be addressed solely through technological advancements. However, universities often fail to raise the critical consciousness toward justice and sustainability. According to the Guardian’s journalist, Stephen Burgen,⁸ no university across the globe offers mandatory climate education to its undergraduate student body, let alone justice discourse in sustainability. Of those who offer sustainability courses, they often confine such courses in narrow disciplinary silos, for example, taught within the natural science department. How can universities act as settings to nurture true interdisciplinary collaborations and increase the capacity for professionals to collectively address the challenges at the intersection of justice and sustainability? How do academic scholars and students become encouraged to envision research beyond traditional disciplinary boundaries and to collaborate with others, including non-technical disciplines (e.g., arts and humanities) effectively?

Universities can encourage faculty to develop research questions that inherently require interdisciplinary approaches, provide funding and support for interdisciplinary research projects, create opportunities for faculty and students from different disciplines to interact and learn from each other, and rethink reward structures to recognize and value interdisciplinary scholarship. For example, universities can conduct frequent interdisciplinary courses, workshops, or panels. By fostering a culture of collaboration and challenging disciplinary boundaries, universities can empower scholars and students to envision research that tackles the intersection of justice and sustainability.

In our journey of becoming sustainability researchers, we have discovered the profound impact of academic diversity. Each team member, coming from distinct academic backgrounds, brought a unique lens to understanding sustainability. Vishal Sharma, situated in the computing discipline, draws from human-computer interaction and ecological economics to study the design and use of sociotechnical systems to promote sustainable development beyond capitalist logic. Sarah Roney researches nature-based methods for restoring, conserving, and addressing environmental degradation, which often requires a partnership between members of the public, government, and policy officials; resource managers; and diverse scientists in sociology, biology, and engineering, among others, to be successful. Olanike Olaomo investigates climate resilience and gender equality among African farmers, drawing from social, biological, and political dimensions of sustainability. Oliver Chapman examines the design of policies to accelerate the development and diffusion of sustainable energy technologies in the electric utility industry and residential households, requiring knowledge of technical, scientific, and engineering research. Carlos Fernandez explores the improvement of electrochemical technologies for sustainable chemical manufacturing while also working with technological, economic, social, and political factors to minimize the negative impacts the implementation and deployment of these technologies have on the global energy, water, and food systems. As graduate fellows, we experienced the synergy that arises when scholars from varied disciplines do not talk past each other but to each other. We discussed diverse ways, as noted within our disciplines, to progress our sustainability and justice ideas effectively across disciplines, filling our intellectual gaps.

Considering the incredibly diverse, broad-reaching, and multi-faceted focus and impacts of sustainability research, academically diverse interdisciplinary teams are necessary where researchers can learn from each other’s understanding of sustainability, justice, and how the two are intertwined. By fostering interdisciplinary collaboration between scholars from diverse backgrounds, universities can equip future generations of sustainability researchers with the knowledge and perspectives to address our complex societal challenges.

NURTURING MULTIFACETED-DISCIPLINARITY

Just the blending of academic disciplines is not enough; it is also critical to consider identity-based diversity (e.g., based on culture, race, ethnicity, gender, sexual identity, and others) within sustainability teams. Scholars from different backgrounds bring unique perspectives shaped by their lived experiences. These perspectives allow for a more nuanced understanding of sustainability challenges. They can assist a team in contemplating the subtleties that its members contribute. By incorporating a wider range of experiences, the team can develop more equitable and inclusive solutions that address the needs of marginalized communities disproportionately impacted by sustainability issues. Lacking identity-based diversity might lead to an increased risk of creating pathways to sustainability that are inappropriate or may result in unintended consequences, “causing more trouble than the situation it’s meant to address.”⁹ By embracing identity-based diversity, sustainability teams can ensure that their recommendations are innovative but also just and equitable for all. As the diversity among us expanded our perspectives and understandings, it may also lead to better decision-making in many other sustainability teams.

Diversity in opinions and identities may cause conflicts, but they can bring alternative, new ideas to the foreground, leading to a richer understanding of complex issues.¹⁰ As we, the authors, shared our diverse ideas and worked together on finding pathways to consider justice and sustainability together, we realized how much we learned from each other’s perspectives, even when they conflicted. Our team is composed of people with different racial, sociocultural, economic, and political identities. The lived experience that we gained from belonging to such diverse identities opened our eyes to how sustainability and justice are realistically enacted in diverse global contexts and how this operationalization differently impacts people from different identities. For example, having members from Asia and Africa made us aware of the “atmospheric colonization,”¹¹ i.e., the disproportionate burden of pollution on economically advancing countries. The unrestricted consumption in the predominately white and economically advanced countries has created a cumulative 92% of global

carbon emissions with only 14% of the world's population. Economically advancing countries, even with large populations, such as India and Nigeria, largely consume within their share of planetary boundaries; however, they end up disproportionately impacted by climate change because of limited infrastructures and capacities for mitigation and adaptation and economic dependence on sectors highly vulnerable to climate disruptions (e.g., agriculture and tourism).

Our team's diversity assisted us in viewing our work from a different perspective. Many cultures in economically advanced countries have been living sustainably, nurturing their traditional wisdom, for millennia despite slaughter, pillage, and colonial exploitation. For example, the *Ubuntu* philosophy from Africa encourages interconnectedness, suggesting that a human being is a part of, and not separate from, the environmental world. Traditional agricultural practices in some regions may involve crop rotation and permaculture techniques that preserve soil health and biodiversity. There is much to learn from such profound cultures with subjective wisdom, which may inspire new sensitivities in sustainability science. Sustainability research, and science in general, however, are still largely Western, reductionist, and objective, a legacy of Western colonization's emphasis on universalism.¹² This negligence of subjectivity fails to consider that knowledge is always produced from a specific perspective, influencing the questions scientists choose to ask and how they interpret results.¹³ Science is not a detached, objective endeavor but is shaped by the scientist's unique creativity, intuition, inherent perspectives, experiences, contexts (social, cultural, and historical), and biases.¹³ As justice and sustainability transcend national boundaries, can we create spaces to study the wisdom effaced by Western science while questioning the epistemic inequity? How can researchers consider objective and subjective knowledge systems simultaneously? If the systems are in conflict, how might they work to support shared values while not disregarding those specific to a particular system? Can they learn "[t]o see from one eye with the strengths of Indigenous ways of knowing, and to see from the other eye with the strengths of Western ways of knowing, and to use both of the eyes together"¹⁴?

Some steps that can be taken are (1) fostering collaborative research teams with members from Western and non-Western contexts, (2) developing methodologies that bridge the gap between objective and subjective knowledge systems, and (3) engaging local communities in research to ensure that their perspectives and knowledge systems are integrated into the research process. If Western and Indigenous or objective and subjective knowledge systems conflict, we can focus on shared values such as environmental protection and social justice.

Expanding the concept of interdisciplinarity to include not only academic diversity but also a diversity of identities and backgrounds is crucial for challenging long-held assumptions that limit our ability to approach justice in sustainability with nuance, global awareness, and inclusivity. We term this approach *multifaceted-disciplinarity*. Multifaceted-disciplinarity expands the concept of interdisciplinarity by integrating knowledge from multiple disciplines and actively cultivating a team with a wide range of identities and life experiences. The concept can be further explored, evaluating the effectiveness of multifaceted-disciplinary teams working on sustainability initiatives. This exploration could then inform best practices on team composition and strategies for addressing potential challenges created by multifaceted-disciplinarity.

FORMING A SHARED UNDERSTANDING

Sustainability and justice are broad, complex, and multidisciplinary concepts. Although researchers across disciplines may focus on these ideas, how they are defined and approached may differ and be disparate within each discipline. For example, views from a biologist with intentions to preserve nature and the rights of other life forms might be at odds with an engineer who intends to build a renewable energy technology to progress global decreases in carbon emissions. Both viewpoints are valid, but how does a team move forward in their decision, and whose viewpoint is considered? How do teams compromise on their priorities or, alternatively, push through their conflicting goals to design entirely new priorities for solutions? Sometimes, sustainability and justice can even be in conflict. In the 1991 meeting of the First National People of Color Environmental Leadership Summit, summary reports proposed 17 principles of environmental justice that have since acted as a critical foundation for many environmental justice organizations.¹⁵ Two of these principles call for the cessation of radioactive material production and the disposal of nuclear materials. These principles stem from legitimate concerns over the disproportionate placement of nuclear facilities, mining, and waste management near marginalized communities. However, this stance overlooks nuclear power's role in mitigating climate change due to its low greenhouse gas emissions, an arguably more sustainable option than current energy prospects. What do we do when the most "sustainable" solution is not the most "just" solution? Do we prioritize sustainability or justice? Who and what factors determine this prioritization? These are some questions that sustainability researchers need to ask, individually and collectively, in and through their work. Here, multifaceted-disciplinarity becomes crucial. By fostering an interdisciplinary team with diverse expertise and backgrounds, the group can navigate these conflicts. By embracing multifaceted-disciplinarity, teams can navigate these complex challenges and arrive at solutions that are sustainable and just.

We are not comparing definitions and approaches to sustainability and justice nor deciding the best methodologies. However, we emphasize the need for a shared framework that acknowledges diverse approaches. This framework could include core values, guiding principles, and methods that can be adapted to specific contexts. Establishing multifaceted-disciplinarity teams can provide an avenue to devise the framework. As sustainability researchers, each of us, the authors, faces diverse and unique challenges to finding just and equitable solutions to environmental problems. As a team, we ourselves hold different perspectives on the definition, priorities, and realities of justice and sustainability. Despite all of this, each one of us, individually and collectively, has found common ground in recognizing the necessity of collaborating in these scenarios; and this is what has brought us together to discuss, rethink, and reimagine pathways to considering and addressing justice and sustainability.

Our disciplines and identities, though separate and distinct, are intimately linked. An environmental scientist from a marginalized community might bring a unique perspective on environmental justice issues faced by their community. Similarly, a sociologist studying social

movements can offer valuable insights into how to build collective action for sustainable change. Experts within each discipline must consider the intersections of identity and interest to find ways to work toward supporting justice and sustainability together.

AN INVITATION

Sustainability predicaments are incredibly wicked, unbounded, and sophisticated. Encouraging researchers to address issues of justice may require additional efforts. However, the concerns of justice in sustainability science are not an optional addition or are left to “justice experts.” We must each act as advocates to shift our sustainability perspective to that of justice. Supporting interdisciplinarity, nurturing multifaceted-disciplinarity, and forming a shared understanding are some suggestions that allow us to consider facets of sustainability and justice, separately and together, with those who have different skills, experiences, and knowledge.

The questions we asked in this paper are vast and complex; they cannot be reduced to simple answers. Asking questions could cultivate a critical consciousness about just sustainability; elucidate the nuances and roles of influential economic, social, and political forces in sustainability; and encourage others to consider their research and motivations to realize more socially just and sustainable futures. Considering the rising social consciousness around justice and sustainability issues, the time is right to call for a more authentic synthesis across disciplines to support the praxis of solidarity that leads to action toward climate change mitigation and adaptation with justice at the center.

We invite sustainability researchers to consider incorporating multifaceted-disciplinary teams into their research to establish and nurture spaces that allow discussion for justice and sustainability. This is not a call for radical disruption but a more calculated, stable, and nuanced shift to break old dichotomies, allowing new justice-driven sustainability science to emerge. A better sustainability science is possible. We can contribute to its realization.

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AUTHOR CONTRIBUTIONS

V.S., conceptualization, writing – original draft; S.H.R., conceptualization, writing – original draft; O.O., conceptualization, writing – review and editing; O.C., conceptualization, writing – review and editing; C.A.F., conceptualization, writing – review and editing; M.C., supervision, writing – review and editing.

REFERENCES

1. Agyeman, J. (2008). Toward a 'just' sustainability? *Continuum* 22, 751–756.
2. Becker, C. (2023). *Insolvent: How to Reorient Computing for Just Sustainability* (MIT Press).
3. Agyeman, J., Bullard, R.D., and Evans, B. (2002). Exploring the nexus: Bringing together sustainability, environmental justice and equity. *Space Polity* 6, 77–90.
4. Nardi, B., and Ekbja, H. (2017). Developing a political economy perspective for sustainable HCI. *Digital Technol. Sustain. Embracing Paradox 1st edition*, 86–102.
5. Howard, L. (2023). Breaking climate justice 'silence' in everyday life: The environmentalist killjoy, negotiation and relationship risk. *Socio. Rev.* 71, 1135–1153.
6. Boden, D., Borrego, M., and Newswander, L.K. (2011). Student socialization in interdisciplinary doctoral education. *High Educ.* 62, 741–755.
7. Tsing, A., and Lassila, M. (2017). Interview with Anna Tsing. *Suomen Antropologi J. Finn. Anthropol. Soc.* 42, 22–30.
8. Burgen, S. (2022). Barcelona Students to Take Mandatory Climate Crisis Module from 2024. *Guardian* 12. <https://www.theguardian.com/world/2022/nov/12/barcelona-students-to-take-mandatory-climate-crisis-module-from-2024>.
9. Sharma, V., Kumar, N., and Nardi, B. (2023). Post-growth Human–Computer Interaction. *ACM Trans. Comput. Hum. Interact.* 31, 1–37.
10. McSorley, M., Arkhurst, B.K., Hall, M., Zha, Y., Spyrou, I.M., Duchesneau, K., Ringania, U., and Chang, M. (2023). For graduate students to become leaders in sustainability, we must transcend disciplinary boundaries. *Elementa Sci. Anthropocene* 11, 1.
11. Hickel, J. (2020). Quantifying national responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary. *Lancet Planet. Health* 4, e399–e404. [https://doi.org/10.1016/S2542-5196\(20\)30196-0](https://doi.org/10.1016/S2542-5196(20)30196-0).
12. Kimmerer, R. (2013). *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants* (Milkweed editions).
13. Haraway, D. (1988). Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective. *Fem. Stud.* 14, 575–599. *Feminist Studies, Inc.* <https://doi.org/10.2307/3178066>
14. Bartlett, C., Marshall, M., and Marshall, A. (2012). Two-eyed seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. *J. Environ. Stud. Sci.* 2, 331–340.
15. First National People of Color Environmental Leadership Summit (1991). *Principles of Environmental Justice*. <https://www.ejnet.org/ej/principles.html>.