Sustainability and Resilience: A Critical Review of Sustainability Literature and Implications to Resilience of US Academic Libraries, Archives, and Information Systems

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Abstract: The field of library and information science (LIS) is one often associated with sustainability. Sustainability is inherent and embedded in the guiding values of the field's education, praxis, and theory as well as two of its main sub-disciplines of human information behavior (HIB) and information communication technology (ICT) systems. Both HIB and ICT are designed with the goal of sustaining information and data access into the future. However, this sustainability traditionally forefronts sustaining material and property into the future versus sustaining the future of the environment, both in terms of the natural environment and natural resource use and in terms of the social environment of people employed within institutional library environments or for sustaining the resilience and agency of communities neighboring academic institutions and their climate justice efforts. This conceptual article reviews the existing literature on economic, social, and environmental sustainability in the LIS field and examines the scholarly conversation concerning critical university studies and environmental sustainability in academic libraries and academic information production infrastructures. Using existing LIS environmental sustainability literature and triple bottom line theory as a framework, this article then suggests potential new considerations for expanding US academic libraries' sustainability in ICT and HIB practices beyond calculating energy use and building emissions. Last, this review ends by highlighting case studies and future research opportunities that offer new perspectives on sustainability in academic libraries. Only by first acknowledging that the colonial capitalist neo-liberal forces accelerating the climate crisis are the same forces that underpin and drive US universities' knowledge production, and by extension academic libraries, and in facing those implications can we then begin to imagine more resilient paths forward.

https://doi.org/10.3998/jep.7211

Keywords: Sustainability, Resilience, Knowledge Production, Academic Libraries, Triple Bottom Line Theory, Library Information Science, Information Communication Technology, Human Information Behavior

The climate crisis directly impacts the lives of everyone on the planet to varying degrees. The impact on human life, non-human life, and ecosystems is well documented. The impacts of the climate crisis and man-made environmental disaster on memory, both material and immaterial cultural memory, tied to humanity's past, present, and future in the form of libraries, archives, galleries, and museums, is only recently capturing scholarly attention (Baillot 2023; Mazurczyk et al. 2018, 112; McMurray 2023). However, this does not mean that non-academic and/or marginalized groups have not already seen the impact of disaster on their cultural holdings in multiple ways. Disaster can come in many forms and is often compounded for marginalized groups, especially in the "global south" (Jones et al. 2022, S157). Sea-level rise, flooding, and natural disasters can threaten archives and collections, but memory material can also be displaced from colonization, occupation, and armed conflict (Gordon-Clark 2012, 53; Winn 2015, 6–7). The more routine disaster of silencing, commodification, and extraction of marginalized peoples is often perpetuated by Western "outsider" academic researchers (Loyer 2021, 31–32).

While experiencing disaster is not new for many, the effects of the climate crisis are being felt in proportion to the degree of power and capital various nations have exploited throughout modern industrial human history, a history that directly caused the environmental crisis faced today. The unequal effects of the climate crisis are reflected in the fact that marginalized communities in the United States and worldwide, such as Pacific Island nations, that have traditionally contributed little or no emissions have borne the brunt of the crisis and disaster (Deivanayagam et al. 2023, 64). While critical scholars have long pointed to the disproportionate impact of climate change on marginalized communities, the increasing awareness and more broadly felt impacts of volatile weather patterns by groups in positions of privilege and power have, in part, led to an increase in urgency and prioritization of academic conversation around climate change. As a recent bibliometric trend study found, academic publishing concerning "climate change/global warming/climate emergency" went "from under 100 articles per year in the first half of the 20th century to over 10,000 articles per year in recent years" (Santos and Bakhshoodeh 2021, 12). Yet recent estimates show we are nowhere near the required decrease in emissions needed to stem inevitable global climate collapse (United Nations 2022).

As Jana Bacevic asks, "Are the ways that knowledge production is embedded in networks of global capitalism shaping how we (can) think about the future?" (2021, 1206). The history of academic research is one full of complications, serving both state power,

militaries, and corporations—and also crucial for climate justice via the creation, distribution, and access to climate research (Carpenter and Mojab 2017; Lamdan 2017; Rodríguez et al. 2024; Strega and Brown 2015). Capitalistic values in the academy often manifest as ceaseless publishing, pressure for novel research production, labor exploitation, scarcity, prioritization of efficiency and scalability, and reliance on digital technology systems (Jessop 2018, 105–6). While there is an increase in research on the impact of the climate crisis on material memory and calls for institutions to do more to protect holdings, this review argues that there is currently a gap in critical research on the ways academia contributes to the problem. There is a need for research concerning the environmental footprint of academic institutional knowledge production and how academic information systems contribute to the climate crisis as well as critical analysis of how institutions and the technologies that power academic research can be more sustainable and resilient, both for sustaining the natural environment and the social environment of people employed within institutions and for sustaining the resilience and agency of surrounding community climate justice efforts (Tansey 2015, 49; 2024, 1–3). Evidence of the lack of meaningful acknowledgment of or work toward reducing resource use in higher education is that of the nearly 400 American higher education institutions to have stated a carbon-neutral goal by 2030 to 2050, only 10 universities have successfully achieved this status (Goldman 2024, 8).

Two distinct conversations emerge when analyzing the topic of sustainability in memory institutions and information systems: (1) What is the environmental footprint of information technology? and (2) How are people storing and accessing environmental information? While this conversation is growing, there is a limited focus specifically on academic library institutions' environmental sustainability and less from a critical university studies perspective on ways to foster a more resilient future in academic libraries versus sustaining an increasingly untenable status quo. This review will seek to evaluate the landscape of library and information science (LIS) literature related to the two aforementioned conversations and draw attention to the opportunity for a study of how US academic libraries might reduce their environmental footprint *and* foster sustainability in archivist and librarian labor, climate resilience, information access, education, and partnership in surrounding communities while acknowledging the dominant power structures the academy works within and with.

The following review will first summarize how sustainability and resilience show up writ large in the LIS field and within academic libraries and the topics it centers on using a triple bottom line theory framework. Triple bottom line theory, developed in the 1990s, reflects a theory of business development that relies on the three aspects of sustainability: "economic sustainability, social sustainability and environmental sustainability" (Chowdhury 2014, 29). Initially a model used by private companies to strategize business growth, it is now utilized broadly, including in higher education

and information fields. I then turn to critically examine sustainability versus resilience literature within the LIS field and in US academic libraries theory and praxis and the LIS subfields of information communication technology (ICT) and human information behavior (HIB). Last, I close by highlighting some alternative models and case studies that challenge the status quo and offer a potential path forward for academic libraries and, by extension, academic publishing and knowledge production. These include models for decentralized cooperative digital preservation networks, community-engaged academic archival collaborations in response to crisis, and recent critical assessments of the role of big tech in the knowledge production systems and its environmental impact (Foster and Evans 2016; Hogan and Roberts 2023; Jarvenpaa and Essén 2023; Shankar et al. 2016; Skinner and Halbert 2009; Walters and Skinner 2010).

Theories of Sustainability in University Libraries

Academic libraries, and modern libraries overall, often deal with a paradox of sustainability: how to balance introducing new technologies while still organizing and preserving traditional information formats (Jankowska and Marcum 2010, 160; Jankowska et al. 2014, 53–54). This complicated balancing act also occurs in an increasingly complex work environment, where librarians often have to fight for staffing, funding, and resources amid demanding job requirements and growing climate volatility, both factors that limit the time and resources that can be put toward sustainability initiatives and can impact the resilience of libraries and librarians in response to crisis (ALA 2018; Munro 2011; Rabinowitz 2024).

While complex and complicated, the term *sustainability* usually refers to one of three main themes: environment, economy, and equity. This is echoed in an American Library Association (ALA) statement, which in 2019 began including sustainability along with access, equity, intellectual freedom and privacy, and public good as "Core Values of Librarianship." The ALA defines sustainability as "making choices that are good for the environment, make sense economically, and treat everyone equitably. Sustainable choices preserve physical and digital resources and keep services useful now and into the future. By supporting climate resiliency, library workers create thriving communities and care for our common good for a better tomorrow" (ALA 2020, 2024). This basic sentiment is often echoed in LIS literature, but there is limited scholarship on how academic libraries are approaching all three goals of economic, social, and environmental sustainability (the literature often focuses on one or maybe two goals) and even less explaining how these goals are being developed and measured or how to empower libraries to create their own resilience resources versus brokering

with third-party companies (Tribelhorn 2023, 2). The paradox of sustainability is also pointed out by G. G. Chowdhury in their book *Sustainability of Scholarly Information*: "Everything that we do—relating to our health and well-being, our economy, our education, our business, science and technology, our progress and our civilization—in some way or the other depends on, and makes use of, natural resources and environment. . . . It is therefore extremely important that we try to understand and protect nature and the environment while at the same time make progress in every sphere of our life and civilization" (2014, 15).

But can we have it both ways? Is it possible to continue to progress, to ceaselessly produce, and still protect nature? As other reviews have noted, libraries and librarians are often seen as "agents for change" and receive calls to "initiate the change that is urgently needed facing global challenges like climate change, poverty, hunger, gender equality, etc." (Mathiasson and Jochumsen 2022, 1278–79). But libraries alone cannot save us. In this article, I examine the gaps that appear in the triple bottom line theory by examining each priority as it appears in the literature. The three priorities are never equally weighted, and as the literature shows, we continue trying to solve for social equity and environmental preservation while never sacrificing or reconsidering economic growth in discussions of sustainability.

Economic Sustainability in LIS

Almost everything comes back to money and notions of "value" in the literature. From an economic standpoint, this goal usually points to and puts the responsibility on library labor: asking how preservation work can be done effectively and efficiently. But optimizing for profit, or measuring economic performance, is very difficult in a service-based industry whose product is often intangible, such as knowledge or research (Chowdhury 2014, 17). To use the ALA's terminology, "library workers" often must shoulder the burden of performing both emotional labor and productive labor while also trying to maintain economic performance. The onus of stewarding more significant climate and social issues in library resources, operations, and programming tends to fall on library workers instead of university administration, who often compound challenging working environments by leading austerity measures (Almeida 2020, 5). These austerity measures take the shape of budgetary restrictions, often putting archives and special collections in basements with known flooding issues, not properly assessing data usage contracts, and year-over-year operational and staffing cuts (Falcone 2021; J. Kim 2023; Paris et al. 2022). Similarly, in their yearly survey of "The State of US Academic Libraries," the Association of College and Research Libraries (ACRL) found that "when adjusted for inflation, average and median expenditures [expenses academic

libraries have spent on personnel, materials/services, and operations/maintenance] have largely declined over time" (2024, 7).

With decreasing funds being earmarked from the administration for university libraries, their staff, and their holdings, there is an increasing turn in academic libraries to the ways that digital preservation, automation, and artificial intelligence can help facilitate the functions of the academic library more "economically," or, said another way, how digital systems can replace the costs of human labor. However, as scholars have pointed out, "digital formats and networking services are costly and require extensive technical, human, and financial support. Additionally, they consume considerable quantities of energy and water, as well as ink and paper for printouts," and any savings that digital systems provide in the short term are negated in the long term (Jankowska and Marcum 2010, 160). As Tyler Walters and Katherine Skinner rightly note, "Digital assets are terribly vulnerable, in large part because digital storage media are not stable. Carefully packing up a set of gold discs or a series of servers full of valuable content and putting them on shelves does not work. Preservation in the digital terrain is always and already an act of will, and one that takes ongoing work for every asset" (2010, 260). This puts growing digital collections in constant danger of "morphing into unusable zeros and ones as a result of such threats as bit rot, hackers, user errors, and natural disasters (including power outages)" (260).

Walters and Skinner (2010) go on to point out that the technical and resource challenge of digitization as an economically sustainable solution is further complicated by the fact that by outsourcing digital information storage solutions to third parties—such as Amazon, Google, and myriad smaller digital archive vendors—memory institutions are undermining their own missions and stability as institutions. The two significant issues with passing digital storage to a for-profit third-party storage provider are worth quoting here at length:

> First, *the core mission of for-profit service providers is not to preserve and provide access to significant digital objects. It is to generate a profit and stay in business* . . . though the service provider might gear its products toward cultural memory organizations, the primary mission of the cultural institutions—to provide access to and preserve culturally significant digital objects—does not transfer to the for-profit organization. . . . Second, if an outsourcing trend takes hold and gains momentum, then cultural institutions *are at great risk of losing their own value proposition and viability as institutions in the digital age*. As has already been demonstrated in other arenas (including access to scholarly journals), others will gladly fill the gaps that we inadvertently abdicate to them with valuable digital services. (Walters and Skinner 2010, 263; emphases added)

To summarize, outsourcing the role of digital cultural preservation stewardship to for-profit companies endangers public cultural memory institutions. Library worker skills, including digital curation assessment, technology expertise, and training in digital management, could be increasingly migrated out of academic and public libraries and into private companies in the name of short-term economic sustainability, which creates a long-term threat to the value of cultural memory institutions. As Walters and Skinner point out, likely "in the end, both parent institutions (which will pay the fees charged by these third-party providers) will pay a high price . . . as may future citizens and researchers" for access to digitized collections stored at third-party off-site locations or in cloud servers (2010, 263). As I discuss later in this article, a long-term economically sustainable model that keeps access and monitoring of environmental and information resources out of for-profit companies could be an in-house cooperative of digitization backup, storage, and management systems that is decentralized with other academic and local memory institutions. The now defunct MetaArchive is an example of digital storage within partner universities instead of outsourcing digital infrastructure to corporate interests. From 2004 to 2024, MetaArchive managed "digital collections of cultural heritage institutions and research libraries spanning three countries across three continents, and nearly a dozen U.S. states" (Educopia, n.d.; Skinner and Halbert 2009, 373).

Environmental Sustainability in LIS

The majority of environmental sustainability–specific discussions often focus on "green" energy-efficient buildings. Starting in the early 1990s, there has been a steady increase in scholarship around the topics of "green" initiatives in LIS and how libraries could "go green" (Jankowska and Marcum 2010, 162). These studies often focused on topics of recycling, paper use, building energy consumption, and "greening" collections (Jankowska et al. 2014, 51). A whole industry has grown around the certification of green buildings and the remodeling for and construction of more energy-efficient buildings, supported by LEED certification, which since its development in 2000 has been the national US standard for commercial and institutional buildings (Antonelli 2008). But how does the construction process factor into environmental sustainability? As the American Institute of Architects has noted, "It takes between 10 and 80 years for a new building that is 30 percent more efficient than an average-performing existing building to overcome, through efficient operations, the negative climate change impacts related to the construction process" (Adam 2019). A potential further area of inquiry that exceeds the bandwidth of this review is the expense (or lack thereof) undertaken by

green architecture initiatives in library and archival spaces and how new green building projects have further impacted natural resources and funds available for staffing resources and community collaboration.

While the intent of this overview is not to say that energy-efficient buildings are harmful or that paper waste is not important to monitor; they are both methods that could decrease the carbon footprint of buildings. Rather, this article seeks to highlight that the stratification of discussions of sustainability appears to miss connections between economic, social, and environmental concerns and fails to address the more significant socio-political cultural values underpinning these prioritizations. For example, the increase of digital collections versus hard copy collections of academic journals presents an entanglement of economic, environmental, and social interests regarding paper use. When hard copies of academic journals were accessible, a few copies could be circulated and returned through the library, which also created more community and interpersonal interaction within the library. With most journals now hosted digitally, multiple users are printing out articles and downloading and storing articles on devices, which takes up energy in the form of electricity and water to preserve server integrity and creates costs for perpetual digital access and subscription (Jankowska and Marcum 2010, 165–66).

There are trade-offs in terms of accessibility, community, and energy use that are worth considering, depending on the values with which you approach the scenario. Yet this nuance seems to be often missed in the discussion of the energy efficiency of libraries and information systems, which defaults to the largest common denominator—which, in the case of most of the literature, focuses on the obvious energy efficiency of the actual buildings and infrastructure. The environmental effects of economically sustainable choices become apparent with a slightly closer examination. Infrastructure is always constituted within broader assemblages, and continuing to critically assess the network that drives certain infrastructure prioritization versus just focusing on LEED certification of buildings could help to understand the repercussions of economically driven decisions on the surrounding natural and social environments (Iliadis and Russo 2016).

Social Sustainability in LIS

Compared with economic and environmental sustainability, social sustainability appears to be the least discussed aspect in the scholarly literature, potentially because it is the hardest to measure and thus does not lend itself to easy surveys or reporting, which are often prioritized in discussions of budget and support but also in academic research (Lampland and Star 2009). In the literature reviewed, the prioritization of

digitization for economic sustainability mirrors current LIS approaches to social sustainability. Library equipment and services are often shifted to computers that need frequent hardware and software updates and have negative environmental impacts in terms of the digital hardware supply chain, which includes forced labor mining for rare earth minerals and exploitative hardware assembly factories as well as electrical use needed to power systems (Fuchs 2015; Khalid et al. 2021). Digital information resources often become the primary way that libraries promote and showcase their sustainability resources through subject research guides, exhibits, library websites, or social media (Jankowska et al. 2014, 46). Overall, research in this area typically focuses on sustaining scholarly communication and information and on the challenges of sustaining print and digital collections indefinitely (Jankowska and Marcum 2010, 162).

However, the absence of social sustainability studies in LIS and the sustaining of community initiatives or environmental knowledge, history, or resources examined in the literature does not mean there is not an interest in fostering more socially sustainable resources. In a survey of sustainability curricula of 203 academic libraries and 58 iSchool faculty/students, Maria Jankowska et al. reported that "both categories of respondents expressed overwhelming support for engaging academic libraries (95%) in campus sustainability teaching, research, and outreach, and LIS programs (88%) in their curricular activities" (2014, 53). Although the support is there, the survey also found that iSchools are rarely prioritizing sustainable classes, resources, or cross-discipline initiatives even if they forefront sustainability adjacent content, such as "focusing on access to information and diverse users; transformation in collection development and management; entrepreneurship in information, ethics, diversity, and change; multicultural services; community informatics; accessibility for information technology; archival outreach; digital curation; digital scholarship and open content" (54). The absence of social sustainability in LIS literature could potentially be due to the complexity of a term like *social sustainability* and how it quickly becomes a catch-all for contemporary trends of social services forced onto already overtaxed library systems. However, as discussed in the next section, the absence of social sustainability could be due more to an overall framing of sustainability versus resilience in LIS theory; historical prioritization of efficiency; and an unnecessary and complicating siloing of social, economic, and environmental sustainability concerns as distinct from one another versus layered, reciprocal, non-hierarchical, and interconnected.

From Theories of Sustainability to Resilience in University Libraries

As seen above, current theories of sustainability in LIS keep coming back to, prioritizing, and are underpinned with economic values that in the US economy are linked

to capitalism. But capitalism has always been in the room with LIS, as Lua Gregory and Shana Higgins argue in their essay, "In Resistance to a Capitalist Past: Emerging Practices of Critical Librarianship": "the proliferation of libraries and the inception of library science as a field of study and as a profession correspond with the rise of corporate capitalism in the United States" (2018, 22). This professionalization and commodification of knowledge and memory creates a situation today where, like other consumer capitalist businesses, "academic libraries . . . are preoccupied with the need to provide evidence of their worth" (Nicholson and Seale 2018, 4). Further corroboration of the priority of "value" can be found in the main objectives of the ACRL "Five-Year Goals and Objectives: Value of Academic Libraries" statement, which lists its second objective as "promote the impact and value of academic and research libraries to the higher education community" (Association of College & Research Libraries 2022; Nicholson and Seale 2018, 4).

As Gregory and Higgins point out, the idea of needing to promote impact and value goes back to the beginning of the profession, with an 1879 ALA motto written by Melvil Dewey comparing the library to a business that is tasked with providing "the best reading for the largest number at the least cost" (2018, 22). Libraries were built and tasked with functioning to the standards of industry, which during the Progressive Era and today have favored practicality, efficiency, connection, and contribution to the market, which in turn has influenced education systems to mirror those same values. This emphasis on cost, savings, and commodification of intellectual value highlights some of the historical origins of tensions in the academic knowledge production system between theory and practice (28). This business model approach "allowed focus, less demandingly, on process over purpose. It was much the surer thing to prove a library had reached more people or had circulated more books, one year to the next than it was even to suggest that the library had transformed individuals or their communities" (27–28).

Sustaining value, however, is different from resilience. "Sustainability and resilience are distinct but complementary concepts. Sustainability prioritizes outcomes; resilience prioritizes process" (Lerch 2017, 5). Resilience becomes an iterative process that attempts to handle short-term challenges and long-term goals without losing the essence of a system or community, versus sustainability, which focuses on a valuable end result. In the example of academic libraries, sustainability becomes an ouroboros of validating and proving efficiency writ large for the largest possible audience of consumers; otherwise, "inefficiencies" will be cut from the budget or optimized. Resilience offers a more community-level approach that, instead of making sweeping changes, seeks to work at various interconnected levels of issues and systems, asking questions such as "Resilient of what, exactly? Resilient to what, exactly? Building resilience how, and benefiting whom?" (Lerch 2017, 5). These questions become increasingly important to

answer, even if the answers themselves are complex and complicated. However, they are important questions to ask on the front lines of LIS education, theory, and praxis; in the implementation of information technology systems; and in the increasingly unsustainable system of academic knowledge production.

While not exhaustive or systemic, it is my hope that the above LIS sustainability review helps to identify where the gaps are in the current sustainability conversation and the epistemologies, ontologies, and philosophies that could potentially be employed to help fill them. The current economic, social, and environmental priorities of sustainability in LIS are deeply linked to Western value systems that prioritize free market, profit, objectivity, and, as Donna Haraway (1988) calls it, the "god trick" of modern scientific and technological systems. The "god trick" employs a sleight of hand that makes us forget the origins of knowledge or influences of power. Decision-making, data, and the scientific logic supporting decisions with economic, social, or environmental impact become imbued with an objective authority that can be mobilized to obscure the priorities driving certain choices (Haraway 1988). While questioning the underlying value systems behind current academic knowledge production landscapes and with a more resilient mindset, we can now move to critically examine definitions and priorities of sustainability and resilience within two main fields of LIS. My hope is that by critically examining where concepts of sustainability and resilience intersect, questions around potential new or different ways of knowing, being, and making meaning in higher education knowledge production can emerge. Next, we explore the two main fields of LIS education, theory, and praxis that underpin knowledge production at the US academy: information communication technology (ICT), or the infrastructure technology that supports our contemporary communication and information landscape, and human information behavior (HIB), or how people seek out or learn to look for information.

Critical, Sustainable, and Resilient ICT and University Libraries

In ICT, a few main perspectives emerge when reviewing the existing critical perspectives in the literature, including the sustainability of technology systems' carbon footprint and sustainability of data theory and praxis with ways to assess data critically and counter data as a panacea solution. Looking at emissions, a few authors examine how to minimize the carbon footprint of preservation and question existing paradigms around measurement. For example, Penn State University (PSU) Libraries' 2021 study of greenhouse gas (GHG) emissions offers a framework for measuring and calculating academic libraries' carbon dioxide emissions using pre-established PSU institutional GHG calculation methodologies as a basis. PSU's librarians believe, as far as they are aware, that this might be the first university library assessment of its kind (Goldman 2024, 10–11;

Mazurczyk et al. 2018, 116). The assessment of infrastructure, while not as sweeping as the PSU recommendations and reporting, is mirrored in scholarship findings showing significantly reduced energy usage by carefully monitored and risk-managed shutdowns of air handling units during unoccupied library hours in selected spaces without compromising quality of material preservation (Linden et al. 2012, 393). Overall, there is a disconnect between the preservation of archival material, be it digitally or via heat, humidity, and climate controls in library buildings, and the negative impact of climate emissions implicated in each of those systems (Abbey 2012, 91; Faulkner et al. 2021, 275–77). All authors mentioned here also point to the need for a systemic literature review of more environmentally friendly information technology in sustainable resilient archives, which poses an opportunity for future research.

While there is a movement for carbon neutrality in public library systems internationally, such as Finland's calculation of Helsinki library emissions, and in some domestic public libraries, such as the Brooklyn Public Library's net zero emissions by 2050 goal, currently there is a lack of academic library research and commitment in this area (Goldman 2024, 8). As mentioned earlier, only "ten [US] universities have successfully achieved a status of certified carbon neutrality through actions ranging from investment in renewable energy to purchasing of carbon offsets" (8). In the absence of alternatives, the PSU calculations offer a framework for assessing GHG data sources such as library square footage, utilities, employee air travel, vehicle usage, data storage for digital collections, remote lending and borrowing, temperature and relative humidity, and library database usage to provide a helpful framework that could be applied to other libraries. To be clear, a framework to calculate GHG data should not only provide insight for the optimization of library systems or be used to achieve potential cost savings but also help transform our understanding of the materiality of data—to understand the water, labor, and natural resources needed to power our knowledge production and information systems (Crawford 2021; Hogan 2015).

Understanding material implications helps to assess digitization efforts and data-forward approaches more clearly and critically. Digitization is not a panacea, and Keith Pendergrass et al. (2019) problematize digitization, noting that while it can serve an important role in preserving cultural heritage, it comes with various drawbacks in terms of access, resource drain, and maintenance. Their examination of cultural heritage sustainability literature identifies a gap in how digital preservation resources are discussed. They call for a paradigm shift in the digital preservation conversation beyond just assessing electricity use in digital preservation infrastructure to reevaluate traditional notions of appraisal, permanence, availability, and resource use in the entire "lifecycle" of digital preservation (166, 174–75). Furthermore, naming and acknowledging the repercussions of data extraction on human and natural resources, the long-term management needs, the political effects data have on choices of sustainable development

and infrastructure, and how temporal dimensions, geographic scale, and usage intent all influence data management strategies can help facilitate more critical questioning of technocentric approaches and the enduring colonial capitalist values embedded in information communication technology systems, academic knowledge production, and sustainability value-based thinking in LIS (Currie et al. 2019; M. D. Kim 2025; Mayernik 2016).

Critical, Sustainable, Resilient HIB and University Libraries

Building on the sustainability calculations of ICT, HIB adds the human element, in this case librarian/archivist labor, to the list of resources needed and used by libraries, academic or otherwise. Libraries, especially after cuts stemming from the height of the COVID-19 pandemic and the 2008 recession, are often severely understaffed and underfunded (Yeh et al. 2021). Lean resources mitigate the hours librarians can dedicate to GHG emission mitigation measures and commit to community access and support of environmental research, resilience, and education as well as librarians' and archivists' own research and education while balancing job requirements (Poole and Todd-Diaz 2022). A number of scholars in this assessment offer a critical perspective on the topic, examining existing literature and likewise calling for a more expansive definition of sustainability. Carli Lowe (2020) points to gaps in existing studies on archival sustainability, calling for future scholarship to focus on the barriers that keep librarians and archivists from implementing sustainability measures or climate resilience measures in their institutions (i.e., barriers to funding, time, staff, etc.). Heidi Abbey (2012) calls for a sustainable practice that goes beyond eco-friendly green buildings to utilize the unique position of libraries and archives as knowledge gateways to serve as environmental educators, partners, and community leaders. From this perspective, more resourced libraries, such as R1 institution academic libraries, could provide climate action plans, GHG calculators, knowledge share networks, or infrastructural support to lesser-funded libraries, community memory repositories, and cultural memory institutions. However, it is important that this support comes with collaborative governance, where each partner institution has an equal say in the project. A case study for this kind of collaborative partnership could be the Digital Library of the Caribbean (dLOC), a trilingual digital initiative across four Florida University partners and five Caribbean partners (Renwick 2011).

Todd Welch's (1999) survey study of 30 archival repositories (state archives, public libraries, academic libraries, and historical societies) in Alaska, Washington, Oregon, California, Montana, and Idaho offers one of the first examinations of how archives are prioritizing environmental concerns in their material collection through accession

and curation of environmentally relevant material and how patrons are utilizing these materials (i.e., environmental law and policy, environmental impact statements, land use, historical geography, environmental history, etc.). Additionally, Fatima Espinoza Vasquez and Shannon Oltmann's (2023) interviews with Puerto Rican activists before and after the disaster of Hurricane Maria forefront the subversive, defensive, and proactive agency people have when faced with information marginalization and information precarity while navigating inequitable local and federal information environments in response to environmental crises and systemic inequity.

Similar to ICT, multiple scholars also critically assess the promise of digital to make HIB resources more sustainable. Bernard Reilly (2016) points to the formidable challenges of divisions of library labor in work to preserve and make knowledge accessible but argues that discussion in the field needs to move past the mass digitization of books and web archiving and acknowledge that labor challenges will not be solved by new technologies alone. Likewise, Nathan Tallman (2021) points to the intrusion of commercial interests into cultural heritage and argues commercial solutions are rarely created with long-term storage and equal opportunity, free community access in mind. In the face of crisis and global climate collapse, putting critical information behind a paywall and charging for access seems antithetical to collaborative problem-solving. Alex Poole (2015) argues, "Science data sharing, access, and reuse benefit scholarship primarily by encouraging new research questions and by allowing the reproduction of previous findings." Following this model and others mentioned in this section, a sustainable and resilient way forward in the face of global crisis involves community collaboration and using academic resources to support and empower local climate justice and resilience efforts instead of investing time, money, and labor into commercial third-party investments.

Conclusion: Sustaining a Possible Resilient Pathway Forward

So why is all the climate crisis information being published not driving a real-world impact? Do more scholars need to work on the crisis? Do we need more information, data, and articles published to understand the stakes? Or could part of the issue be that the foundational values behind the academic work of solving the climate crisis are tainted by being tied to the same institutional values revered by the colonial neoliberal capitalism that got us into this problem in the first place? To end back at the beginning, this review evaluates the landscape of LIS literature related to HIB and ICT conversations and considers a potentially new conceptual approach to how US academic libraries reach sustainability in the broadest sense. This means reducing their environmental

footprint *and* fostering sustainability in archivist and librarian labor, climate resilience, information access, education, and partnership in surrounding communities while acknowledging the dominant power structures the academy works within and with. To answer Bacevic's earlier question—"Are the ways that knowledge production is embedded in networks of global capitalism shaping how we (can) think about the future?" (2021, 1206)—this researcher would argue that, yes, knowledge production's embeddedness within networks of global capitalism keeps us from thinking about a future we want to inhabit, potentially because that future is shaped in the vein of our current oppressive system. It makes for a future many cannot, or do not, want to fight for. A new conceptual or theoretical approach to sustainability in LIS needs to be tied to critical ontologies, epistemologies, and philosophies that forefront resiliency with community and not reliance on private corporate entities.

By examining HIB and ICT environmentally focused literature in this review through the context of sustainability theories in the LIS field, we are able to see the over-reliance on economic value systems in current sustainable approaches to library and information science education, academic libraries knowledge preservation, access, and research supporting academic publishing. Glimpses of what alternative value systems could look like, which are more focused on social and environmental sustainability and resilience, come through in the HIB and ICT literature examined. For instance, the aforementioned and now defunct MetaArchive, a cooperative decentralized digital preservation network, once offered non-commercial, sustainable, crowd-funded, collaborative, cooperative governance digital backups and ICT systems between 15 universities for almost 20 years (Educopia, n.d.; Skinner and Halbert 2009; Walters and Skinner 2010). Another example of community resilience is the Washington University Library collaborating with its neighboring community on the Documenting Ferguson Project, which facilitated rapid response collecting with the intent to preserve and make accessible relevant born-digital content for future generations (Foster and Evans 2016). This project also sought to develop relationships to ensure community environmental history is documented with increasing attention to the effects and co-shaping of data narratives based on use and users (Foster and Evans 2016; Shankar et al. 2016). Last, Mél Hogan and Sarah Roberts (2023) and Sirkka Jarvenpaa and Anna Essén (2023) offer critical assessments of the role of big tech in knowledge production systems and its environmental impact and provide important considerations and methodologies for assessing corporate technology companies' role and motives within academic archives and libraries, information accessibility, and the futurity of knowledge production. Further research into alternative models of preservation and knowledge production will allow us to envision a future that focuses less on sustaining profit and more on supporting community, nature, and resilience.

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